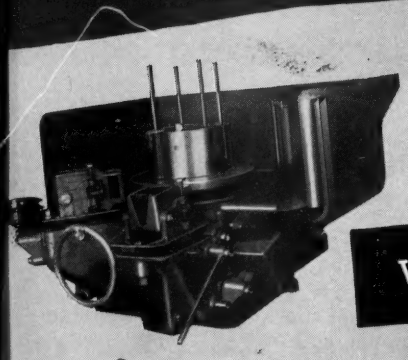
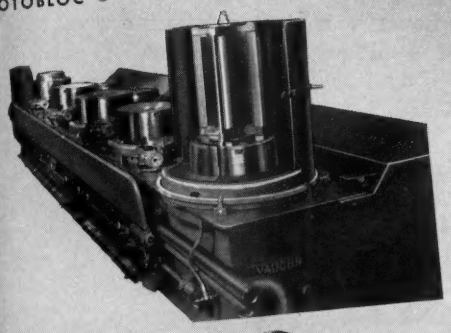
WIRE
AND WIRE PRODUCTS
NOVEMBER 1951

Vaughn

WIRE DRAWING MACHINERY



OTOBLOC ®



MOTOBLOX ®

RINGBLOX ®

-lets you match wire production with today's wire sales!

The safe, high operating speeds of modern Vaughn Machinery, combined with efficient production flexibility, enable the wire manufacturer to keep consistently abreast of current demand—with profits aided by Vaughn operating economy!

THE VAUGHN MACHINERY COMPANY
CUYAHOGA FALLS, OHIO, U.S.A.

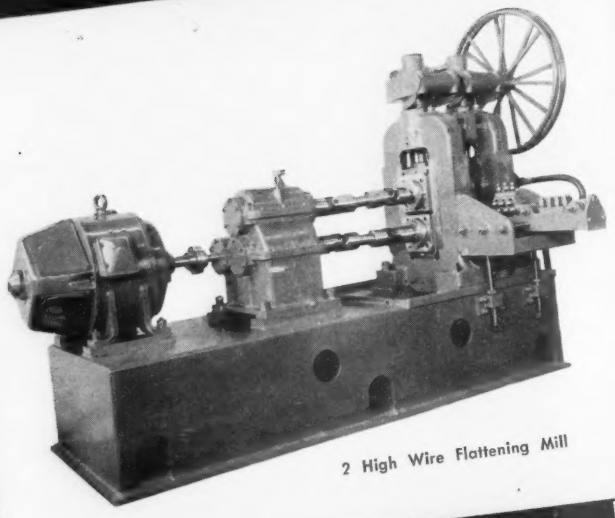
COMPLETE COLD DRAWING EQUIPMENT—Continuous or Single Hole . . . for the Largest Bars and Tubes . . . for the Smallest Wire . . . Ferrous, Non-Ferrous Materials or their Alloys.

OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION

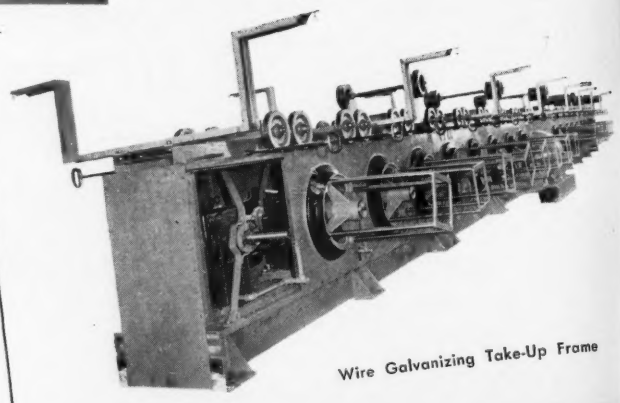
Wean

Equipment Corporation

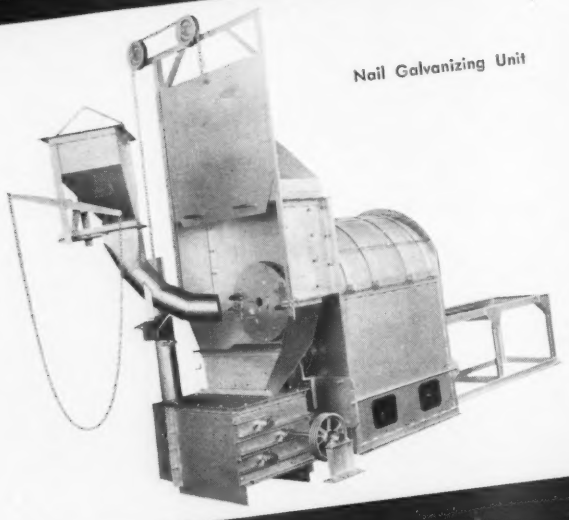
CLEVELAND, OHIO



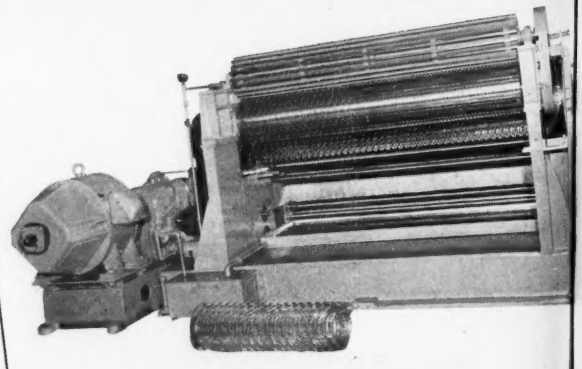
2 High Wire Flattening Mill



Wire Galvanizing Take-Up Frame



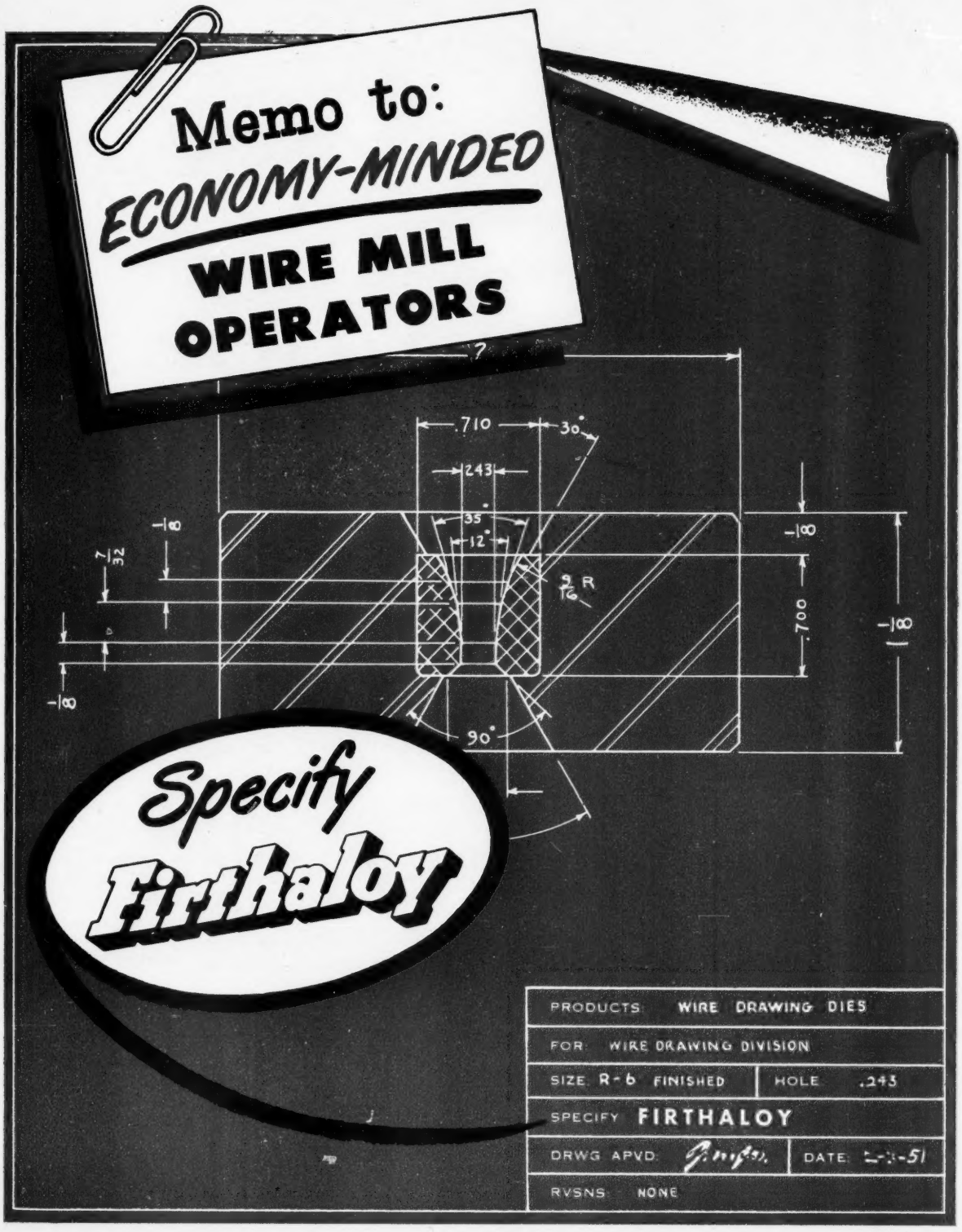
Nail Galvanizing Unit



Hexagon Netting Machine

IN the past few years tremendous progress has been experienced in the field of wire machinery. Production speeds have been tripled and quadrupled. Product quality has been greatly improved. Machines have been made easier to operate and maintain.

THE Wean Equipment Corporation has been a large contributor to this advancement. Wean wire mill specialists have designed, built, and installed wire mill equipment for the leading wire producers the world over. If you make wire you should look to Wean for the best in machinery, service, and facilities.



R-225

Firth Sterling
STEEL & CARBIDE CORPORATION

DETROIT • DAYTON • CLEVELAND • HARTFORD
NEW YORK • CHICAGO • PITTSBURGH
PHILADELPHIA • LOS ANGELES • BIRMINGHAM

Linked by steel with the outside world

This farm home, though it's deep in the country, now has the convenience of telephone service — thanks in part to a strong, bethanized wire known as Bethtelductor. More and more rural areas are enjoying the benefits of telephone service because of the economies made possible by this special-purpose wire.

Combining high tensile strength, excellent corrosion-resistance and suitable electrical conductivity, Bethtelductor is a low-cost conductor. Also, its strength permits spacing telephone poles up to twice as far apart.

The bethanized coating of pure zinc is applied electrolytically in a unique process. Atom by atom, a uniform zinc jacket is perfectly bonded to the steel. Twist it, bend it, even draw it through dies — there's no flaking or peeling of the pure, ductile zinc.

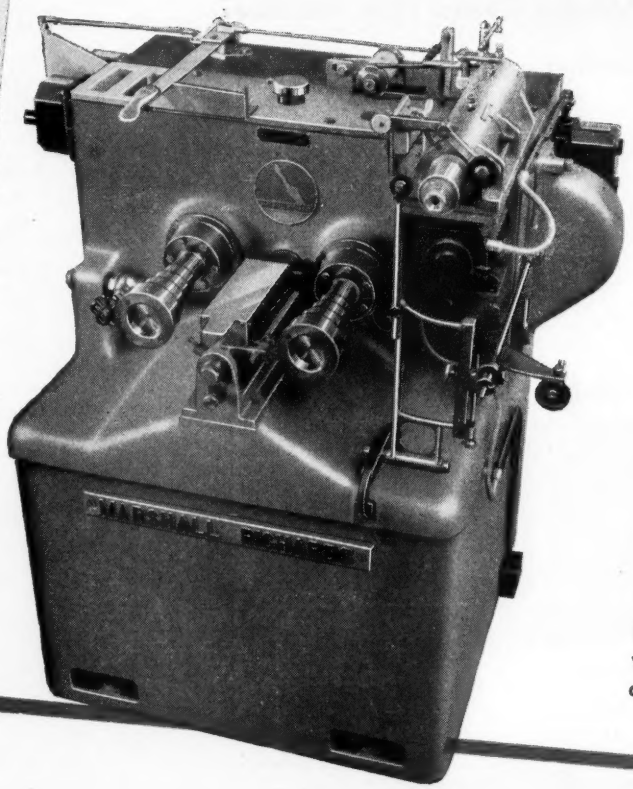
Bethanized wire finds hundreds of uses. It's ideal wherever extra corrosion-resistance is needed. And the ductility of the coating enables it to withstand severe forming. Coating weights and tempers can be varied to suit a wide range of applications.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

★ Bethanized Wire ★ BETHLEHEM STEEL ★

MORE PRODUCTION
from Constantly Improving Design



The 10.F. shown here — a superfine machine for finishing wires below .002" —is a good example of continuously improving design.

The Specification now includes:

(1) Improved spooler with push-on spool spindle.

(2) Liquor control.

(3) Adjustable finishing die to eliminate curly wire.

(4) Automatic stop when the spool is full.

Our customers are always teaching us practical methods of improving our machines.

Every improvement is at once embodied which can make our machines capable of MORE PRODUCTION.

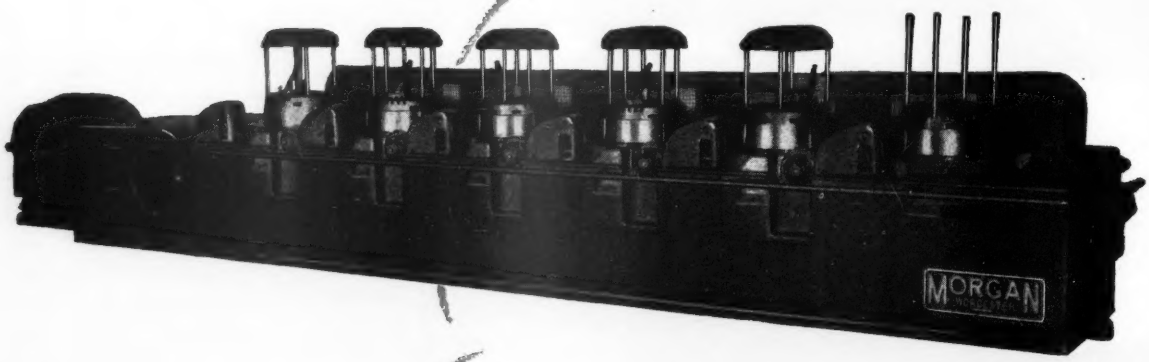
MARSHALL RICHARDS MACHINE COMPANY • INC.

1100 SOUTH BROAD STREET • TRENTON 10 • NEW JERSEY
TELEPHONE: TRENTON 9478 • TELEGRAMS: MARICH • TRENTON

Can you draw .090" rope wire at 1200 RPM finishing at 255,000 psi tensile with an average wire temperature of 200°F 10 seconds after leaving the dies?

This is the kind of performance being achieved on Morgan-Connor Wire Machines. Efficient air cooling is the answer.

WM-56



Replace with

ROLLING MILLS
MORGOIL BEARINGS
REGENERATIVE FURNACE CONTROLS
AIR EJECTORS
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MORGAN-CONNOR
WIRE MACHINES

MORGAN CONSTRUCTION COMPANY • WORCESTER, MASSACHUSETTS

WIRE
AND WIRE PRODUCTS*

Reg. U. S. Pat. Off.

A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable.

DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 26 NOVEMBER, 1951 No. 11

Designated as Official Publication By The Wire Association

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FLANGED STEEL TRAVERSES

. . . offer wire rope users and manufacturers rugged construction, simple 4-step reel assembly and long life—the same qualities that have made them first choice of thousands for wire and cable reels.

Niles Flanged Steel Traverses are manufactured in a wide range of sizes up to 56" diameter and 48" traverse... in plain, painted and hot dip galvanized finishes. The special "Reinforced Type" has *extra strength* where it is needed most—at bolt holes and base of the flange—yet saves weight through use of lighter gauge steel. Width of flange and number of bolt and drain holes are furnished to your specifications. Available for prompt delivery. Write for prices.

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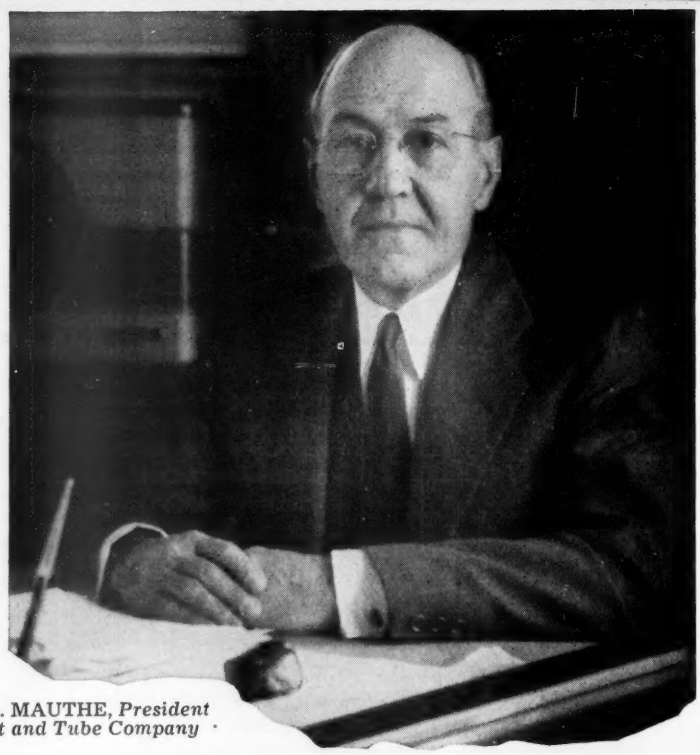
NILES STEEL PRODUCTS DIVISION

REPUBLIC STEEL CORPORATION

NILES • OHIO

Why is the **scrap** situation so **critical?**



An interview with J. L. MAUTHE, *President*
The Youngstown Sheet and Tube Company

Why are you concerned about iron and steel scrap, Mr. Mauthe?

Our inventories are critically low and the present scrap flow is not sufficient to maintain capacity steel plant operations. Furthermore, if the flow of scrap is not increased, a curtailment of steel production is inevitable.

The industry is using all the pig iron and all the home scrap that is available. The balance of our metallic requirements must be made up through procurement of purchased scrap. Every ton of scrap that we do not get represents a ton of steel that we cannot make.

How much scrap does the industry need?

In 1950, 96,700,000 tons of steel ingots and castings were produced, requiring over 61,000,000 tons of iron and steel scrap.

In 1951, over 65,000,000 tons of scrap will be required, and even more will be needed in 1952.

Where does scrap come from?

About 58% of the total scrap required is produced by the ingot and casting makers, and is known as "home" scrap; the balance of 42% is "purchased" scrap and is procured from outside sources.

Purchased scrap generally falls into two categories: Scrap from current fabrication and that which is the result of obsolescence.

There are three important sources from which we get obsolete scrap, much of which is dormant:-

1 - Obsolete machinery and equipment in every industrial plant, at the oil fields and on the farms.

2 - Battlefield scrap, obsolete ships and war material, surplus machinery and equipment, which government can make available.

3 - Countless old automobiles and trucks, which are rusting away in automobile wrecking yards in every section of the country.

What can be done to increase tonnage of purchased scrap?

This scrap must be made available immediately! All industry and government must awaken to the critical nature of the situation. They must realize that if we do not get the scrap, they will not get the steel!

YOU CAN HELP - YOU MUST HELP!
NO SCRAP - NO STEEL

QUALITY YOUNGSTOWN SERVICE

The Youngstown Sheet and Tube Company - Youngstown, Ohio

101 YEARS OF SERVICE

In Recognition
Of the Founders, Managers and Employees of this Company who have so fully contributed to the Economic and Social growth of their Community, the State of Connecticut and the United States of America for more than
One Hundred Years
THE MANUFACTURERS ASSOCIATION OF CONNECTICUT, INC.
Awards this CERTIFICATE of APPRECIATION to
The Hartley Tool & Die Co.
Established in Connecticut 1850
In Witness Whereof these presents have been signed, sealed and delivered by The Manufacturers Association of Connecticut, Inc., This twelfth day of September, A.D. One Thousand Nine Hundred and Fifty
PRESIDENT

With five generations of Hartleys ever striving to serve you better and more efficiently.

It is small wonder, then, that Hartley's Tungsten Carbide Dies have attained a degree of excellence that spells savings for you in your wire drawing operations.

The Hartley Tool & Die Compan is proud to reproduce the certificate recently awarded to it by the Manufacturers Association of Connecticut for their long period of successful service to its community, the state and to industry.

Long-experience and ingenuity in the manufacture of wire drawing dies and other standard carbide products has made Hartley Dies both lower in first cost and more economical in wire, tube, heading and other production costs.

You need not guess as to the quality of your dies if they bear the HARTLEY trade-mark.

Special and shaped dies engineered to meet your needs.

Send for catalog and price list on standard carbide dies.

WATCH FOR THE HEART ON *Every* DIE

your assurance of highest quality and service

L E Y

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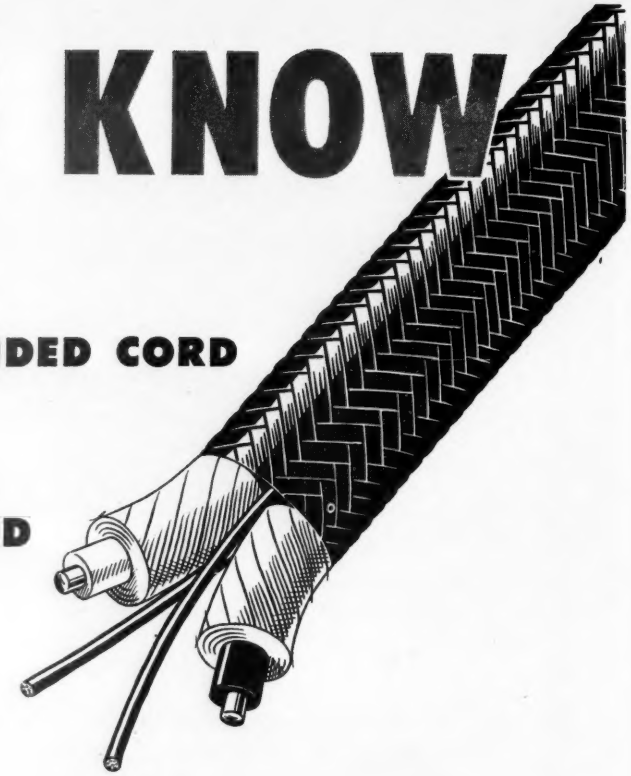
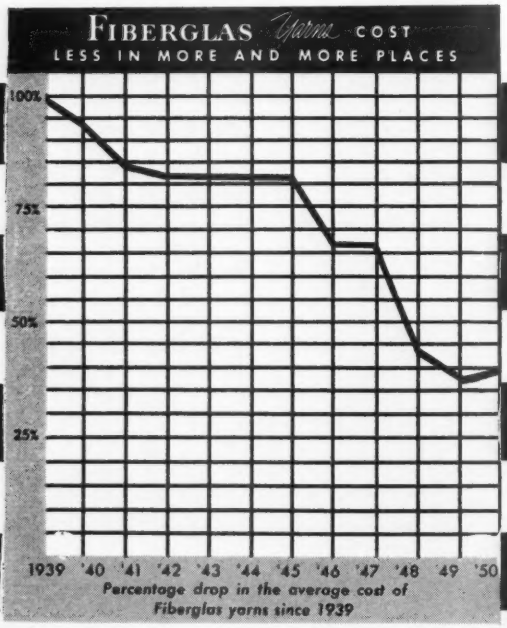
DO YOU KNOW

WHY THE NEW FIBERGLAS* BONDED CORD IS USED AS FILLER IN NON-METALLIC-SHEATHED BUILDING CABLE?



...BECAUSE


FIBERGLAS Yarns COST
LESS IN MORE AND MORE PLACES
100%
75%
50%
25%
1939 '40 '41 '42 '43 '44 '45 '46 '47 '48 '49 '50
Percentage drop in the average cost of Fiberglas yarns since 1939

FIBERGLAS BONDED RIP CORDS

- HAVE GREATER MOISTURE RESISTANCE
- HIGH TENSILE STRENGTH . . . CONFORM BETTER TO THE SPACE TO BE FILLED
- AND ARE LOW PRICED FOR A SUPERIOR PRODUCT!
- DO YOU KNOW OF OTHER APPLICATIONS FOR THIS NEW AND VERSATILE PRODUCT?

*Fiberglas is the trade-mark (Reg. U. S. Pat. Off.) of Owens-Corning Fiberglas Corporation for a variety of products made of or with glass fibers.

For complete information about Fiberglas for this and other uses, write Owens-Corning Fiberglas Corporation, Electrical Sales Division, 16 East 56th Street, New York 22, N. Y.

OWENS-CORNING FIBERGLAS Yarns

FIBERGLAS IS IN YOUR LIFE...FOR GOOD!

Wire Trouble?

When wire twists and tangles as it uncoils, you lose production time. That's why Chase mills pay so much attention to the "cast" of Chase copper alloy wire. Uniformity of temper and stress makes Chase wire conform to the shape of the coil and unwind smoothly.

It is free from physical defects . . . uniform in gauge, texture and color. For cold-heading, Chase wire is tops. Write for folder "Chase Cold-Heading Extruded Brass and Copper Alloy Wire."

"DO" orders: Our metallurgical engineers are familiar with military specifications for brass and copper for ordnance components, and will be glad to consult with you on the selection of these metals for defense orders.

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With the Pennsalt Foscoat® Process you can INCREASE WIRE DRAWING SPEEDS UP TO 80% without equipment change . . .

Note difference in appearance between wire drawn by conventional lime practice (top), and wire drawn by the new Pennsalt Foscoat Process. The Foscoated wire was drawn at speeds resulting in a 40% increase in production. Despite this speed-up, die life was increased 2½ times.

A series of tests under actual commercial operating conditions has conclusively demonstrated that the new Pennsalt Foscoat Process offers many production-boosting, cost-lowering advantages.

With the Pennsalt Foscoat Process actual production can be increased more than 40% . . . in fact wire drawing speeds are now limited only by the mechanical capacities of the drawing machines. Speed increases of 80% are entirely possible.

In addition, you can often triple die life and eliminate high temperature baking operations. With this new Pennsalt Foscoat Process you can get more consistent drawing results and far greater corrosion resistance, as well as a truly finished appearance without subsequent operations . . . *all without equipment or process flow changes!*

The new Pennsalt Foscoat Process consists of compatible cleaning, pickling and the application of a new phosphate coating, together with specially-developed lubricants. This produces a heat-resistant surface that remains unbroken even under the most severe forming pressures.

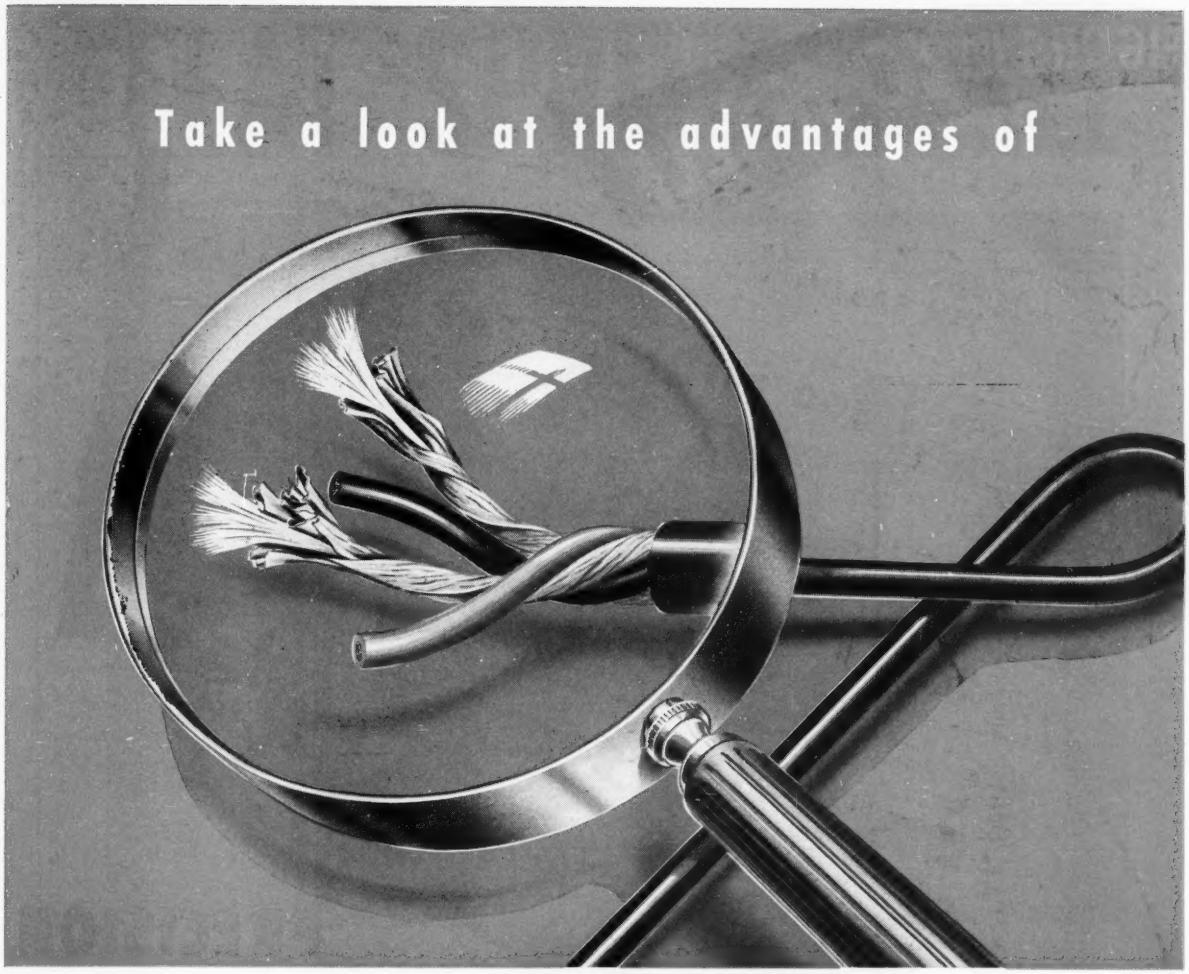
Investigate Pennsalt Foscoat. Write about your operation on your letterhead and we will tell you how the Pennsalt Foscoat Process can speed your output and probably lower your costs. Pennsylvania Salt Manufacturing Company, Philadelphia 7, Pa.

Foscoat works equally well for tube drawing, deep drawing and cold heading, as well as for ordnance work.

PENNSALT CHEMICALS

for Industry • Agriculture • Health • Home

PROGRESSIVE CHEMISTRY FOR OVER A CENTURY



Textilene GLASCOR®

(FIBERGLAS - CENTERED FILLERS)

- **Better stripping action**
- **Greater uniformity**
- **More flexibility**
- **Wide range of tensile strengths without any change in bulk**

These new revolutionary fillers with a Fiberglas core were developed by Twitchell with the help of Owens-Corning. Textilene GLASCOR has been approved for portable cords and is now being used by many large manufacturers. Talk to Twitchell about its specially developed fillers for nonmetallic, shipboard, underground and varnished cambric cables, and wire rope. Supplied untreated or impregnated to resist moisture, fungus, mildew and dry rot *— in endless length packages.*

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TWISTED • FOLDED • PRESSED • CRUSHED • SHAPED • BRAIDED • WOVEN

FIGURE IT YOURSELF

TIN SAVINGS* in Pounds During One Shift Operation of a 20-wire Unit at Typical Plating Speeds

Wire Size B & S Gauge No.	500 FPM	700 FPM	900 FPM
40	8.5	11.9	15.3
30	27.0	37.8	48.6
20	85.6	119.7	153.9

* Based on the 60-millionths thickness difference between 20-millionths inches, required for ASTM test, and 80-millionths, usual hot dip thickness. Operating shift period is 7½ hours.

HERE'S THE TIN YOU WOULD SAVE BY PRECISION WIRE COATING with DU PONT HALOGEN TIN PLATING PROCESS

THE table shows the tin savings you can make during *only one shift*. Think of the savings in metal and dollars that are possible over the period of a week . . . or a month . . . or a year!

Because the Du Pont Halogen Tin Process permits precision control of the coating thickness, 20-millionths inches of tin (more than enough to pass the ASTM test) can be applied more easily and uniformily than the 80-millionths usually put on by the hot dip process.

Using equipment that is simple, easy to install and operate, the Du Pont Halogen Tin Process produces a superior wire coating at higher speeds and at lower cost. It is the same process which has proved so successful in steel plants for electrotinning strip.

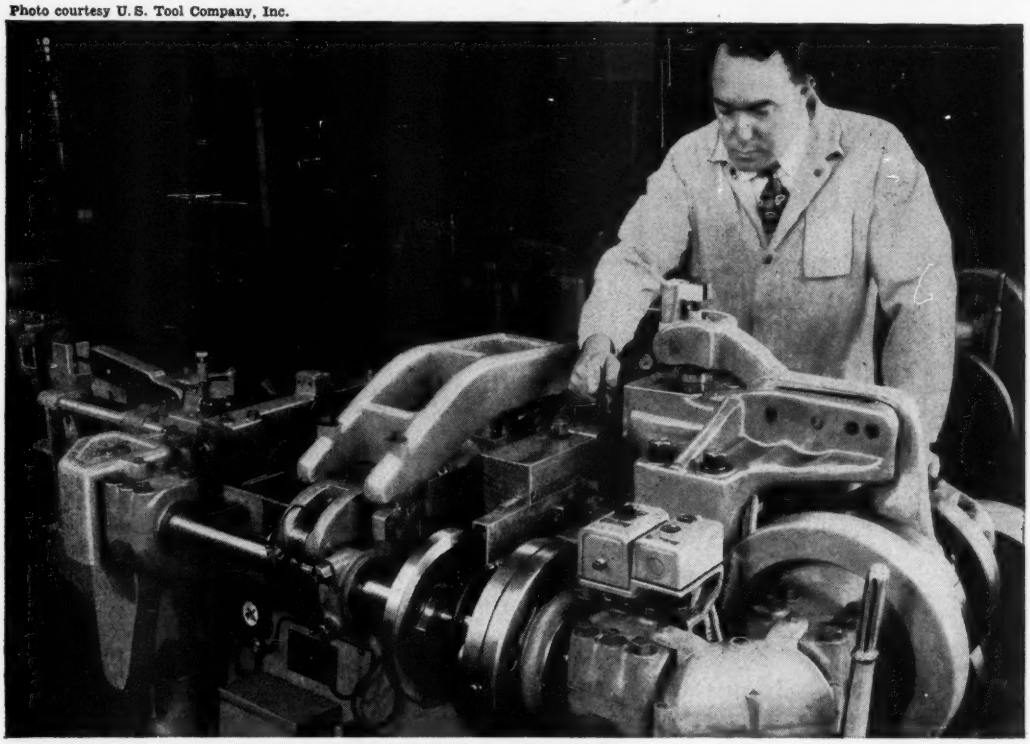
Let us tell you more about this process . . . how it can speed up your production . . . conserve critical tin . . . save precious man-hours. Just call or write to the nearest office of E. I. du Pont de Nemours & Co. (Inc.), Electrochemicals Department, Wilmington, Delaware. District Sales Offices are located in: Baltimore, Boston, Charlotte, Chicago, Cincinnati, Detroit, El Monte (Calif.), New York, Philadelphia, Pittsburgh, San Francisco.

DU PONT
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

FLAT SPRING STEEL

Photo courtesy U. S. Tool Company, Inc.



You can always count on Roebling for absolutely uniform quality

FOR FLAPPER VALVES, shoe shanks, measuring tapes! For steel rules, curtain springs, snap springs, lock springs, drop wires, sinker steel and a thousand and one other exacting uses, you'll find that Roebling high carbon flat mechanical spring steel is unsurpassed.

Roebling's complete facilities for producing flat spring steel give us positive control over all phases of manufacture. The final product is dimensionally and metallurgically uniform... cuts down machine stoppages... minimizes rejects. And Roebling flat spring steel is made as you want it—annealed, hard rolled untempered; scaleless tempered; tempered and polished, blued or strawed.

Large quantities of Roebling specialty wires—flat, round and shaped—are required today in the national rearmament program. You can look to us, however, to do everything possible to meet your requirements. John A. Roebling's Sons Company, Trenton 2, New Jersey.

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A NEW LIGHT WEIGHT ALUMINUM SPOOL DESIGNED SPECIFICALLY FOR FINE WIRE PACKAGING

Look what it gives you! *Light weight—strength, durability*—in the 2½" and 3" sizes you've wanted for years! Absolute assurance of uniform delivery over head of spool with minimum end breakage. Brilliant, sparkling sales-appeal that improves the appearance of your fine wire packaging. Less maintenance, longer life, lower shipping costs, greater satisfaction. Ask us about this new 2½" and 3" ACROPAK!

SPECIFICATIONS

Flange	Traverse	Barrel	Arbor
2½"	3"	1¾"	.635"
3"	3" - 3¼" - 3½"	1¾"	.635"
3"	3" - 3¼" - 3½"	2"	.635"

*Reg. U. S. Trade Mark

ACROMETAL PRODUCTS INC.

Division U. S. Bobbin and Shuttle Co., 616 Fifth Street N., Minneapolis 1, Minn.

STANDARD WIRE DRAW No. 990

A NEW COMPOUND HAVING ALL THE ADVANTAGES OF HIGH TITRED FATS, YET A SOFTER COMPOUND. SOFT ENOUGH TO PENETRATE HEAVY LIME ON ROD AND YET BE TOUGH ENOUGH TO STAND HEAVY DRAFTS.

STANDARD WIRE DRAW NO. 991

IS THE SAME TYPE OF COMPOUND AS NO. 990, BUT SOMEWHAT HARDER. BOTH COMPOUNDS SOFTER THAN NOS. 90 AND 91. PRACTICALLY NO LUMPING IN THE DIE BOX AND *LESS COMPOUND WILL BE USED.*

SATISFACTORY FOR RODS, PATENTED AND PROCESSED WIRE

If you have not tried either of these compounds, we advise you to do so. These two new compounds are an example of our never-ending research to improve our products and develop new compounds for better wire drawing.

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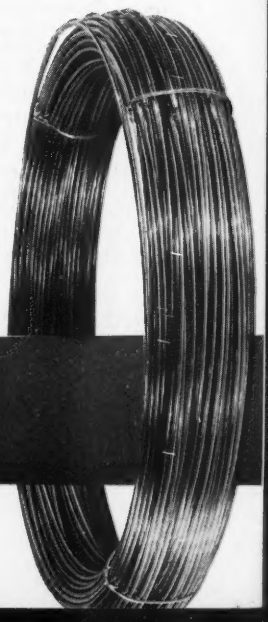

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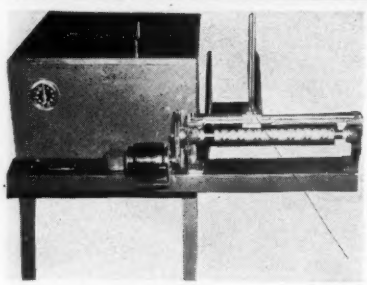

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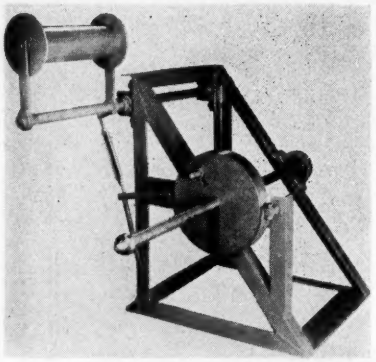

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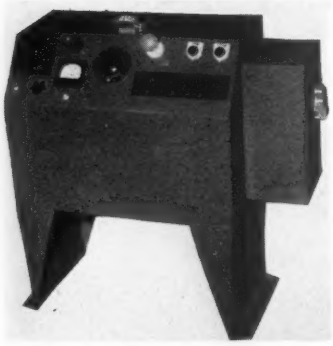

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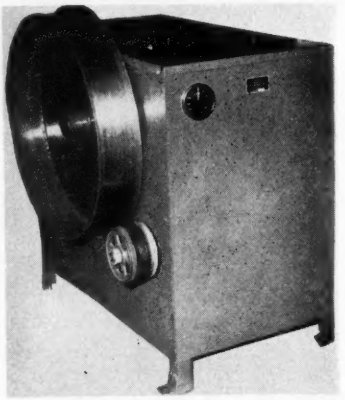

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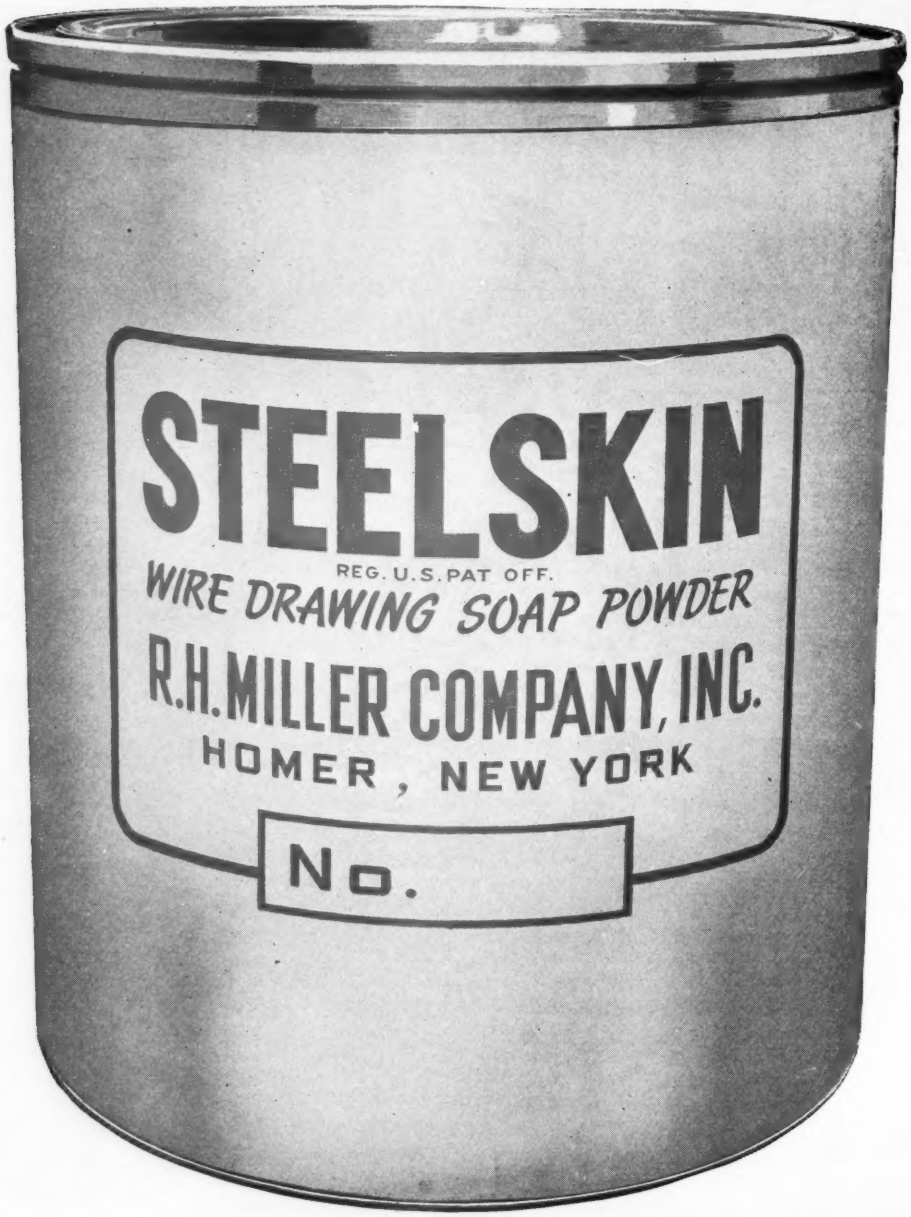

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The Wire Outlook

Hope for an early truce in Korea has all but faded, with the war now likely to carry through the winter. A major war with Russia soon is a remote prospect and a war over the Iran dispute is held to be unlikely. But the foreign situation will keep the rearmament program in high gear.

The business come-back from the slump that began last Spring has been slow, but retail sales are now increasing—a good index that activity will grow steadily through the last quarter. However, production of all kinds will travel an obstruction-lined road due to shortages, controls and continued conversions.

Steel and aluminum concerns will shortly face a day when their sales staffs will have to go out and get orders. Reflecting the heavy demand for steel, for instance, 28 more steel-making furnaces and 11 new blast furnaces have been added since 1948, lifting the country's capacity by 11 per cent. 104.5 million tons of steel should be poured in 1951. By 1953, steel capacity should be 118 million tons.

80% of this greater production is going into hot-rolled products, as against 78.7% three years ago. Electrically welded pipe and tubing manufacture for gas transmission has risen 153%, although on all other types of pipe the increase has been only 43%. Of interest to wire men is that although steel capacity is up 11%, wire rod production has only advanced 4.2%—to 6.4 million tons in 1951. In view of the severe shortages in the rod supply, a percentage increase in keeping with other forms of steel would do much to alleviate our crying need for wire.

Copper and brass product fabricators are feeling the pinch of lack of copper to such an extent that many mills have had to go on a short week. While the government has financed some new production, the copper supply situation is likely to get worse before it gets better, especially for non-defense production. Those requiring tungsten, cobalt, nickel and chrome are having trouble, as these metals are in high demand by the armament program.

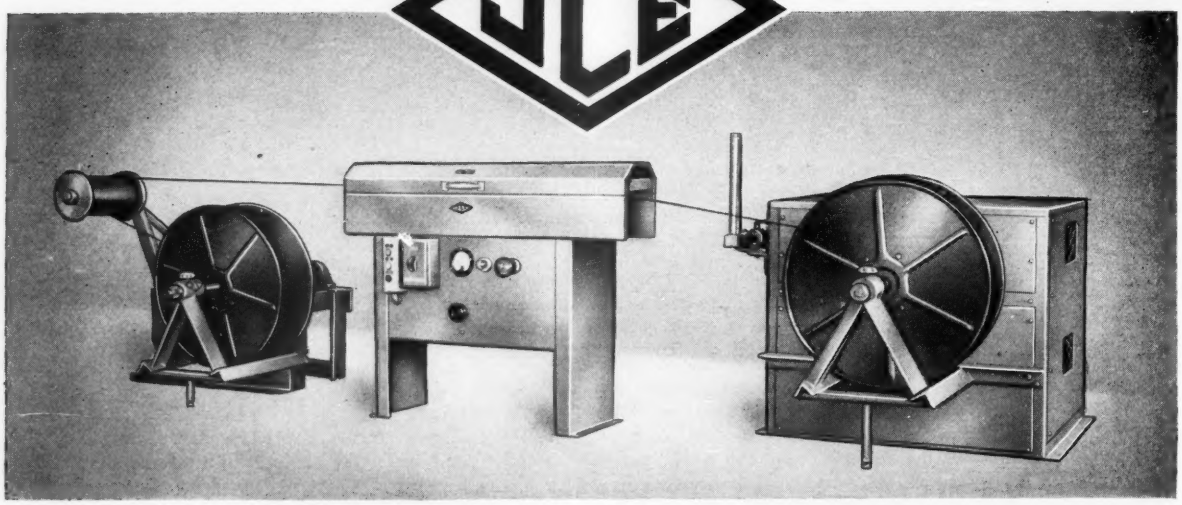
Canada has not been resting on its oars. While drawing on us for many essential metals, its own production of steel—and of those products made from steel—wire, nails, fencing and so forth—have risen. In the first half, Canada's wire production rose to 190,962 tons as against 174,050 tons for the same period last year.

Wire rope supply appears to be generally adequate with new orders failing to materialize on an important scale. Nail stocks are better, but woven wire fencing and barbed wire are in short supply. Lower consumption of some types of wire products has led to a better supply of high carbon specialty wire. The curtailment of automotive production has also slackened the demand for valve springs and other wire forms required by that industry. Inventory regulations are somewhat responsible for the lowering of pressure of demand on the wire mills, which nevertheless continues high as an overall consideration. Readjustment to a war economy always causes some slack at one point or another and we are certainly entering upon a full-scale war economy, the way world affairs are going.

Our country could feel more assured of its future if it could have faith in the Administration. The present Executive arm of our Government, like the last, appears to be bent on circumventing the Constitution, defying Court decisions (we refer to the expropriation of the Dollar Steamship Line by the Government), scoffing at laws, frustrating investigations and barring the introduction of sorely needed reforms and economies in government. A good housecleaning is indicated.

While the present is a period of great activity, in which no one need be idle, the average man would feel better about his future were he represented in Washington by men of caliber, character and common sense.

—from the Editor's Desk



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*Equipment illustrated with additional attachments for DR-8 Reels.

See Page 1069 for a complete listing of JLE Products for the Insulated and Bare Wire Industry.

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Vol. 26 NOVEMBER, 1951 No. 11

HIGH STRENGTH COPPER-SILVER, COPPER-IRON, AND COPPER-IRON-CHROMIUM WIRE

by Webster Hodge, Ass't Supervising Metallurgist,
Ralph A. Happe, Research Engineer, and
Bruce W. Gonser, Assistant Director
Battelle Memorial Institute
Columbus, Ohio.

This paper delivered at the annual Convention of the Wire Association in Chicago on October 22, 1951 discusses some new copper-base alloys that have been made into wire to produce some unusual properties. They are the result of a development program carried on at the Institute for the Army Signal Corps. The use of an insoluble metal like iron, uniformly distributed as reinforcing fibers through the copper matrix is an interesting new concept in wire making.

Over a period of several years, an alloy-development program was carried on at **Battelle Memorial Institute** to find new alloy compositions that could be used to produce a wire having both high tensile strength and high electrical conductivity. This work was sponsored by the **U. S. Army Signal Corps.**

★ ★ ★

The greater part of this work was directed toward developing alloys suitable for making WD-1/TT Wire. The alloys sought had to combine strength-conductivity properties to the extent that a seven-strand cable of 0-011-inch wires of uniform composition would equal, or exceed, the strength and conductivity of a similar standard cable made of four strands of hard-drawn copper and three strands of steel music wire. Such a standard wire has an average conductivity of about 50 per cent IACS and a tensile strength equal to about 150,000 psi. After a thorough search and intensive effort, two alloys [1, 2] and a method of working were developed that fulfilled these requirements.

★ ★ ★

This paper describes the making of experimental lots of WD-1/TT Wire from these two alloys, and covers in greater detail the development of a copper-iron-chromium-base alloy for possible applications when high conductivity is not such an important factor.

Copper-Silver Alloys

First and best of the new alloys was a binary copper-silver that could be drawn readily to 0.011-inch-diameter wire having a tensile strength of 160,000 psi. or over, and at the same time an electrical conductivity of 70 per cent IACS or better. This wire had excellent spring properties and an apparent corrosion resistance in an industrial atmosphere equal to that of pure copper. Since such an alloy composition is not new, it is apparent that the very excellent strength-conductivity combination obtained is a result of the method of preparation.

★ ★ ★

Alloys were prepared in the laboratory by melting the copper and silver together under charcoal in a clay-graphite crucible, and cast in a neutral (nitrogen) atmosphere. To allow casting in air, various deoxidizers were tried. The best of those tried, although not the most convenient to add, was magnesium. Later, it was found that very small additions of phosphorous have little effect on the properties, and it is suspected that boron may be better than either.

★ ★ ★

A 2500-pound lot of this alloy was cast at the American Brass Company mill in Waterbury, Connecticut, for the Signal Corps. The alloy composition chosen was:

Silver per cent	**6.5**
Magnesium, per cent	**0.02**
Copper	**Balance**

★ ★ ★

The alloy was melted under charcoal and cast into 2⅛-inch-diameter x 80-inch-long water-cooled molds. Serious difficulty developed immediately in the casting process because magnesium oxide formed a thick mush that was carried into the molds. After a number of trials, **Mr. D. R. Hull** of the American

(1) W. Hodge, R. I. Jaffee, J. G. Dunlavy, and H. R. Ogden, "A High-Strength High-Conductivity Copper-Silver Alloy Wire", Transactions AIME (IMD), Vol. 180 (1949), pp. 15-31.
(2) "A Copper-Base Alloy Containing Iron as a High-Strength, High-Conductivity Wire Material", Ibid., pp. 32-41.

Brass Company found that about a half-pound of borax glass, added to the charcoal cover over a 660-pound melt, absorbed the magnesium oxide and permitted sound ingots to be poured.

★ ★ ★

The ingots were solution annealed and cold rolled, reannealing several times to soften the material and to get all of the silver into solid solution in the copper. Cold rolling, followed by solution annealing, scalping, and drawing reduced the rods to ¼-inch diameter. After the final full anneal, the wire was removed from the machines and subjected to a heat treatment of 15 minutes at 400°C. ± 5°C. in a bath of mixed sodium and potassium hydroxides and sodium cyanide. After the salt-bath precipitation treatment, the coils were quenched in water, cleaned, and drawn to 0.011-inch diameter. The hardening effect of cold working after a precipitation heat treatment is the distinguishing feature in the production of high-strength wire from a binary copper-silver alloy. The precipitation heat treatment alone weakens, rather than strengthens, the wire.

★ ★ ★

Alloy compositions with four per cent or more of silver responded well to this treatment. The maximum strength obtainable was about 140,000 psi. with 4 per cent of silver, about 150,000 psi. with 5 per cent of silver, 157,000 psi. with 6 per cent of silver, and over 160,000 psi. with 7 per cent of silver. All of these strengths might be exceeded in some heats. It was very difficult to obtain total solid solution of more than 7 per cent of silver in copper.

★ ★ ★

Wire drawing was carried out on the conventional machines, operating at normal speeds, and with the same lubricants used by the American Brass Company for other copper-base alloy wires. Cleaning of the annealed wire presents something of a problem. The larger wire sizes were cleaned by tumbling with bran. The 0.064-inch wire was cleaned in a sulphuric acid-soap solution. The drawn wire tins easily. Making 7-strand cable in planetary strand-ers presented no difficulties peculiar to the alloy.

★ ★ ★

The Okonite Company of Paterson, New Jersey, applied insulation to the stranded cable cores and made them into double-conductor WD-1/TT cable according to the Signal Corps' accepted specifications for WD-1/TT Wire.

★ ★ ★

Since the first commercial lot described was made, Handy and Harman Company of New York have been producing small lots of six per cent silver alloy deoxidized with phosphorus for distribution to various industries.

Economic Considerations

Copper-silver alloys, when treated as described to develop maximum strength and conductivity, present no difficult problems in melting, casting, rolling to rod, drawing to wire, and insulating. The cost of fabrication should be but slightly higher than for handling copper alone. Some 50 miles of wire were fabricated, insulated, and tested in an experimental test on a commercial scale without revealing any unexpected weaknesses.

★ ★ ★

Silver, being a relatively expensive metal, naturally adds to the cost of the metal used in the wire. At present, the metal cost of a 6½ per cent silver-copper wire amounts to about four times the cost for copper alone. Since other costs are about the same, however, the final cost of the finished wire may not be excessive for applications where a high-strength, high - conductivity wire of uniform composition is needed. The chances are not good for the use of this wire as an immediate replacement of the composite copper-steel WD-1/TT Wire, even though the combined strength-conductivity properties are much greater, since more copper is required and copper is in short supply.

Copper-Iron Alloys

The second alloy system that was found capable of producing suitable wire for WD-1/TT Wire was a copper-iron-magnesium alloy whose composition could be varied within fairly wide limits without serious effect on the properties. However, the electrical conductivity was found to decrease as the iron was increased. To obtain the required combination of tensile strength and electrical conductivity, it was found to be desirable to keep the iron between 10 per cent and 15 per cent of the total, and to have a magnesium residual left in the alloy of 0.1 to 0.35 per cent. The small variation in tensile strength and conductivity within this range is illustrated by the data in Table 1, obtained on wires from two experimental heats.

★ ★ ★

A fifty-mile lot of tinned and stranded double-conductor insulated and twisted WD-1/TT cable of 12.5 per cent iron-copper alloy was made for the Signal Corps. Although easy to produce in small ingots, difficulty was encountered in making large ingots for wire bars. This difficulty consisted almost entirely of finding a suitable furnace and crucible material. The alloy was melted in high-frequency induction melting units. Crucibles of clay graphite could not be used, because of the necessity of keeping the carbon low. At the relatively high temperatures required, copper penetrated the walls of the magnesia crucibles often used to melt iron. Silica crucibles were not

TABLE 1. PROPERTIES OF HAND-DRAWN COPPER-IRON ALLOY WIRE

Heat No.	Diameter, Inch	Elongation, % in 4 inches	Tensile Strength, psi.	Conductivity, % IACS
21*	0.0105	0.25	162,000	55.4
21	0.0105	0.50	159,000	55.9
86+	0.0111	1.5	157,000	56.1
86	0.0111	0.75	157,000	56.3

*89.4Cu, 10.1Fe, 0.15Mg, 0.005Si.
+84.1Cu, 15.2Fe, 0.10Mg, No Si.

tried. Possibly they would have been better, although some corrosion from oxide slags would be expected. Melting in the low-frequency induction units used for many copper alloys was unsuccessful. These furnaces had rammed-in acid linings that were protected with an acid slag on the melt. Three unfavorable things occurred: (1) the slag got into the narrow heating channels, choking them up; (2) the iron became entangled in the slag and remained unmelted; and (3) the power factor dropped seriously, often allowing the melt to cool in the furnace.

★ ★ ★

The lot produced for the Signal Corps was finally cast at Battelle, using magnesia crucibles in a high-frequency induction furnace. Since no wire-bar molds were available, the metal was cast in a seven-inch-square, big-end-up, solid copper mold, and hot forged to 3½-inch-square wire bars after scalping. To promote castability, the 12.5 per cent iron melts were deoxidized, after melting under a partial cover of $CaO\text{-}Al_2O_3$ flux, with successive additions of 0.10 per cent manganese, added as ferromanganese, 0.10 per cent silicon, added as ferro-silicon, and 0.15 per cent magnesium, added as 15 per cent magnesium-copper alloy. The manganese addition appeared to effectively degasify the melt.

★ ★ ★

The forged bars were hot-rolled to 5/16-inch rod, annealed, pickled, and cold-drawn to 0.011-inch wire. Coils were resistance welded end to end during drawing. Cleaning of the wire after annealing is complicated by reprecipitation of copper on the iron dendrites that are exposed. Wear on the dies, however, was reported as normal. As a result of these experiences, the conclusion was reached that the alloy can be hot forged, hot or cold rolled, and drawn without any especial precautions or difficulties.

★ ★ ★

Properties obtained from the copper-iron alloy, like those from the copper-silver alloy, depend upon working after a precipitation heat treatment. The best treatment found was to heat the wire to about 900°C. (1650°F.) for ½ hour or longer, quench, reheat to 650°C. (1200°F.),

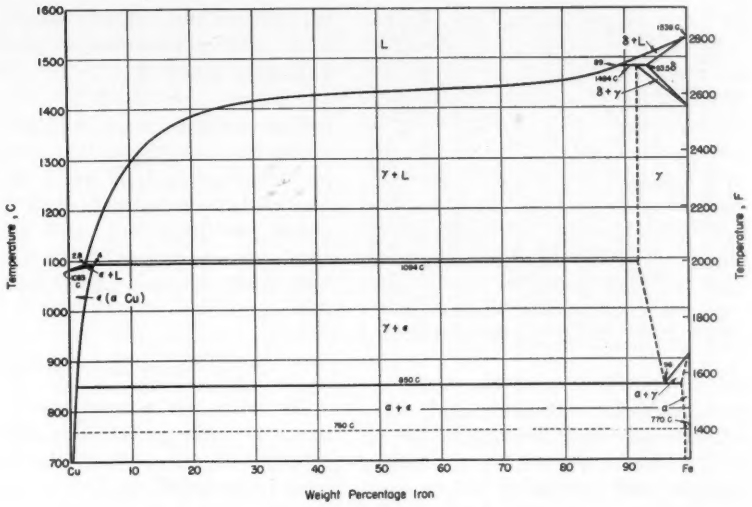

FIGURE 1 CONSTITUTION OF COPPER-IRON ALLOYS
(From A S M Metals Handbook, 1948)

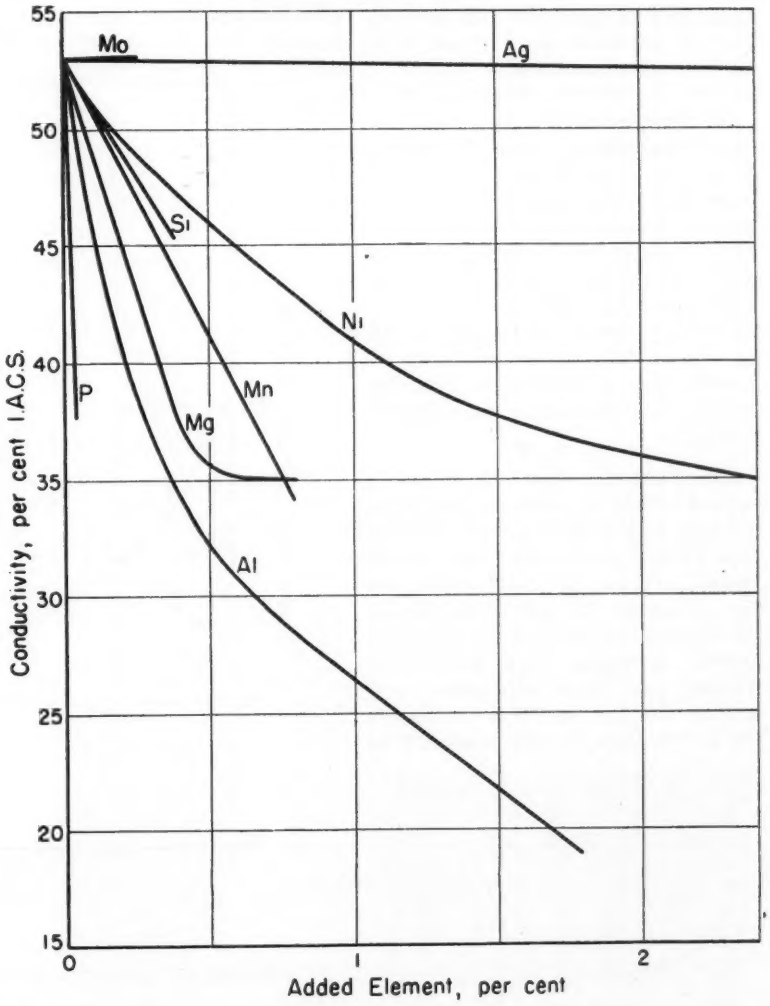

FIGURE 4 EFFECT OF VARIOUS ADDED ELEMENTS ON THE ELECTRICAL CONDUCTIVITY OF Cu-Fe-Cr ALLOYS

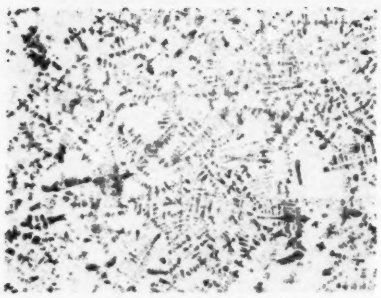

Fig. 2—As-cast, nital etch; intended composition: 25 per cent Fe, 0.75 per cent Cr, 0.15 per cent Mg, and balance Cu

and cool very slowly. The same result could be obtained, and more conveniently, by reheating to 650°C. for one hour, quenching or cooling rapidly, and repeating the process at 550°C. and 450°C., followed by a final 2-hour treatment at 400°C. Drawing was carried on between steps, and the final five B & S numbers of reduction were given after the last heat treatment.

★ ★ ★

No further production of wire has been undertaken from this alloy. However, a single heat was made later in a 500-pound, Type U 'Lectromelt furnace with a basic lining. In this heat, the magnesium was added to the ladle after tapping. It seems possible that with a little more experience, the alloy could be successfully melted in a direct-arc furnace of this type, avoiding many of the difficulties encountered earlier.

★ ★ ★

The 0.011-inch wire was found to have a tensile strength varying from 155,000 to 170,000 psi., and elongation of 1.7 to 2.8 per cent in 10 inches, and an electrical conductivity of about 47 per cent IACS. Samples taken after tinning showed tensile strengths from 164,000 to 171,000 psi. These strengths were higher, and the electrical conductivity lower, than of wire produced in the laboratory. After tinning, the wire was cabled on a planetary stranding machine.

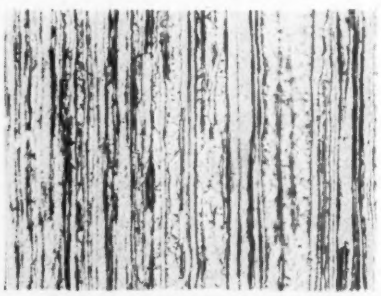

Fig. 3—0.135-inch-diameter wire as annealed 1 hour at 845°C.; 28.4 per cent Fe, 0.92 per cent Cr, 0.24 per cent Mg, balance Cu. Grained material is copper-rich phase

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The tinned, seven-strand cable made for the Signal Corps had a breaking strength of 108.7 to 109.3 pounds, a resistance of 25.4 to 26.0 ohms per 1000 feet, and weighed 13.81 pounds per mile. The strands will rust in moist air unless they are tinned.

Copper-Iron Base Alloys

As with the copper-silver alloy, there is little probability that this copper-iron-magnesium alloy will be used immediately as field wire, even though such a homogeneous strand has some advantages and the strength-conductivity properties are satisfactory. Such wire uses more copper than the composite strand now in use. It may be cheaper to produce than the composite strand, however, since the copper-iron draws much more easily and with fewer anneals than high-carbon-steel piano wire.

Copper-Iron-Chromium Base Alloys

During the investigation of the copper-iron alloys, several quaternary alloys were investigated briefly. Among these was an alloy containing 28.4 per cent iron, 0.92 per cent chromium, 0.24 per cent magnesium, balance copper. This alloy was reduced to 0.0118-inch wire and found to have a tensile strength of 214,000 psi., and an electrical conductivity of 34.9 per cent IACS. A slight improvement in corrosion resistance over chromium-free wire was noted. This pointed the way to the possi-

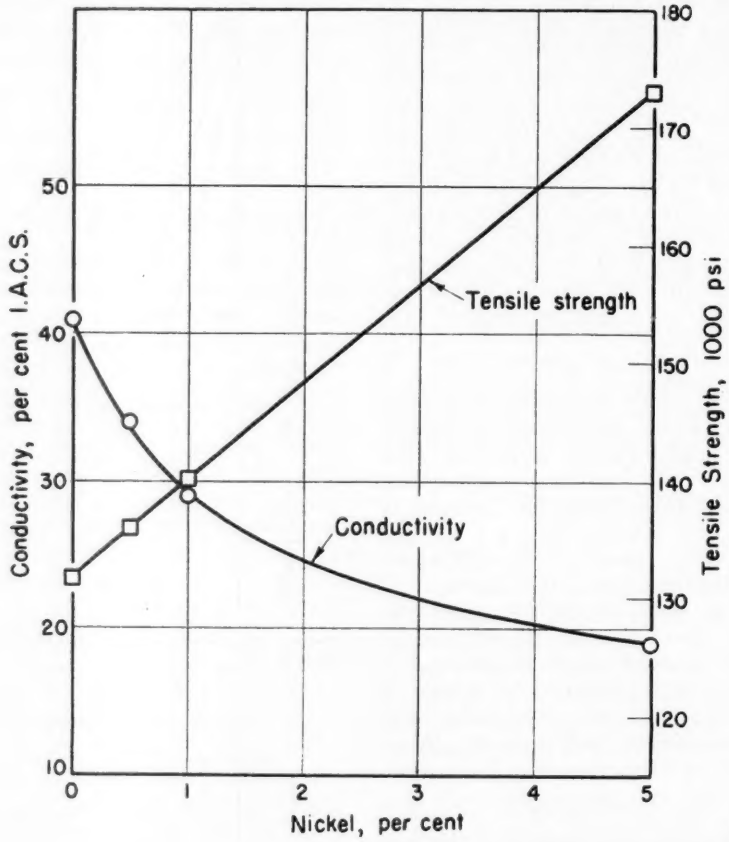

FIGURE 5. EFFECT OF NICKEL ON THE PROPERTIES OF Cu-Fe-Cr HARD-DRAWN WIRE

25 per cent Fe, 1.5 per cent Cr, balance Cu and Ni-13 B and S gage (0.072") - 93.5 per cent reduction after full anneal

bility of obtaining a non-rusting copper-iron alloy having unusual characteristics.

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The Signal Corps decided to pursue the investigation of the complex copper-iron alloys further, with the object of producing a wire for open communciations work. This wire should have a minimum tensile strength of 150,000 psi. and more than 30 per cent of the conductivity of copper when drawn to 0.1040-inch diameter. In addition, the wire should withstand atmospheric corrosion to approximately the same degree as does pure copper.

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It was found early in the investigation that when enough chromium was added to a copper-iron alloy to prevent rusting, the wire did not work harden any more than the low chromium iron alloy mentioned previously. It was also found that while the high tensile properties observed in the 0.011-inch wire could be duplicated with higher chromium contents, a fourth element was required to obtain high strength at the larger sizes. Also, it soon became evident that the total amount of iron permissible was sharply limited.

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Copper and iron are completely miscible in the liquid state, provided the carbon is sufficiently low. Referring to the copper-iron constitution diagram (Figure 1), it can be seen that iron begins to freeze out of a 20 per cent iron alloy at about 2550°F. (1400°C.). Iron dendrites continue to separate from the melt as the temperature drops until, at about 2000°F. (1094°C.), the entire melt freezes. The iron dendrites will be found quite uniformly distributed throughout the mass in a normal chill-cast ingot. If too much carbon is present, however, the iron and copper separate into two liquids. If this happens, uniform distribution of iron in the copper matrix can not be achieved. The maximum carbon in a non-segregated ingot has not been determined. Typical microsections of wires drawn from good ingots are shown in Figures 2 and 3.

★ ★ ★

Chromium dissolves in both iron and copper while liquid. When chromium in considerable amounts is added to a liquid copper-iron alloy, and then cooled, the greater part of the chromium is found in the iron dendrites, so that the copper phase contains only about 0.4 per cent chromium. As would be expected, if the chromium-iron dendrites contain enough chromium to equal about 12 per cent of their weight, they become very resistant to oxidation in moist atmospheres. Thus, the iron dendrites, by addition of chromium to the alloy, can be converted to stainless steel. The small amount of chromium remaining in the copper largely precipitates on subsequent heat treatment.

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Chromium, like carbon, appears to limit the liquid solubility of iron in copper. Analysis of samples taken from segregated regions of the copper-iron-chromium-magnesium alloy after solidification established the practical limits of the two-liquid region, roughly, as about 17 per cent Fe, 2.24 per cent Cr on the one hand, and about 70 per cent Fe, 10 per cent Cr on the other in an alloy containing 0.8 per cent magnesium. This means that between these limits of composition, liquid immiscibility will occur and evenly distributed dendrites of the iron-rich phase can not be obtained.

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It was suspected that magnesium has a broadening effect on the two-liquid region so that, for practical purposes, using less magnesium, an iron content of 18 per cent and with chromium sufficient to cause stainlessness appeared to be a safe maximum.

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The cause of this liquid immiscibility was not established. The alloys may be very sensitive to carbon, which caused liquid immiscibility in the copper-iron system, or it may have been an extension of the region of liquid immiscibility that exists in the copper-chromium system.

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A ternary Cu-Fe-Cr alloy with 18 per cent of iron and 2.5 per cent of chromium is rust-resistant. It can

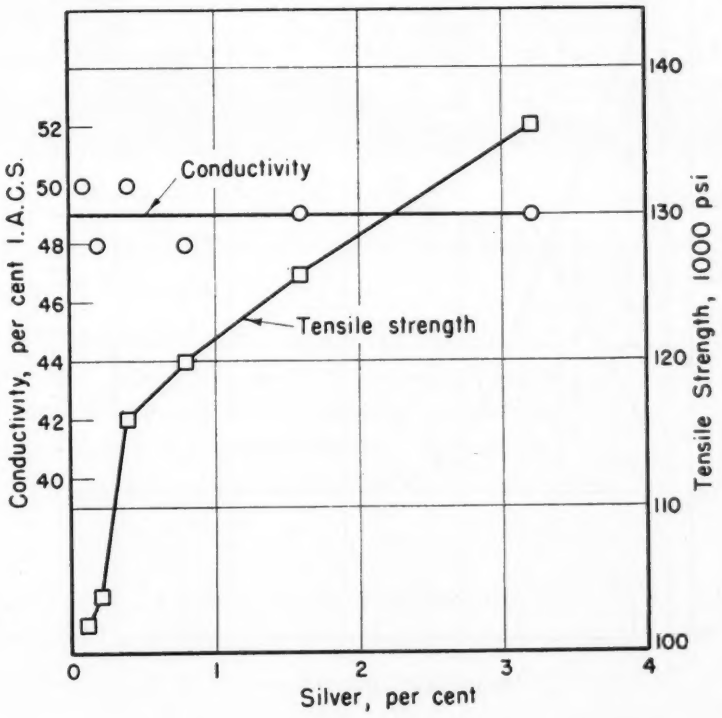

FIGURE 6. EFFECT OF SILVER ON THE PROPERTIES OF Cu-Fe-Cr HARD-DRAWN WIRE

20 per cent Fe, 2.4 per cent Cr, balance Cu and Ag-6 B and S gage (0.162")-94.1 per cent reduction after full anneal

be drawn to have a tensile strength of about 110,000 psi. and a conductivity of about 47 to 50 per cent IACS at 0.104-inch diameter, or a strength of about 200,000 psi., and a conductivity of 30 to 35 per cent IACS at 0.012-inch diameter. A fourth element is required to obtain increased strength in the larger sizes.

Quaternary Additions

Alloying elements added to the copper-iron-chromium alloy could be chosen to dissolve in the copper-rich phase, the iron-rich phase, or both. Elements that dissolved in the copper-rich phase had to be chosen with care, however, since appreciable solid solubility of these elements seriously affected the electrical resistance of the alloy, as can be seen in Figure 4. Only two elements, silver and magnesium, were found that strengthened the alloy without destroying its value as a conductor. Elements that dissolved only in the iron-rich phase, such as molybdenum and vanadium, did not strengthen the alloy. Nickel is the principal example of an element soluble in both principal phases.

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Finally, three quaternary alloys were discovered that showed promise. All of these alloys contained about 18 per cent iron and 2.5 per cent chromium optimum, some proportion of the quaternary addition, and the balance copper.

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Figures 5, 6, and 7, which follow, are included solely to demonstrate the effect of the quaternary addition on strength and conductivity. The values plotted, while accurate for the conditions defined, do not necessarily represent the best properties obtainable.

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Nickel, in an amount equal to five per cent of the weight of the total alloy, makes strong, ductile wire. Hard-drawn 5 per cent nickel alloys easily reached tensile strengths of over 140,000 psi. at 0.102-inch diameter and over 170,000 psi. at 0.072-inch diameter, as is seen in Figure 5. However, the electrical conductivities were respectively, 20 per cent and 18 per cent IACS. This conductivity is too low for communications wire, so no further development of the Cu-Fe-Cr-Ni alloys was attempted. However, it is probable that even stronger alloys of this type can be developed if electrical conductivity is not a limiting factor.

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Silver, added to the copper-iron-chromium alloy, increases the tensile strength without lowering the electrical conductivity, as is seen in Figure 6. An addition of two per cent of silver produced an alloy of better than average ductility, a tensile strength of about 150,000 psi., and an electrical conductivity of 48 per cent IACS. The amount of silver is not critical, but ductility and strength both increase with increasing amounts of silver. Another outstanding property of this alloy is its stability when exposed to higher temperatures. A 3.2 per cent silver alloy drawn to 139,000 psi. at 10 gage lost less than 5000 psi. after four hours at 550°F. Lower temperatures had almost no effect on the alloy. Except in cost of materials, the silver-bearing alloys were the most attractive of any found in this investigation.

★ ★ ★

Magnesium, added to the copper-iron-chromium alloys, can be made to produce wires of tensile strength and electrical conductivity nearly equal to those of the wires of the silver series. (See Figure 7.) The amount of magnesium added must be controlled within close limits. An alloy of 18 Fe, 2.5 Cr, 0.45 to 0.55 Mg, balance copper was found to draw to wire of about 150,000 psi. tensile strength and 35 to 45 per cent IACS conductivity. Less than

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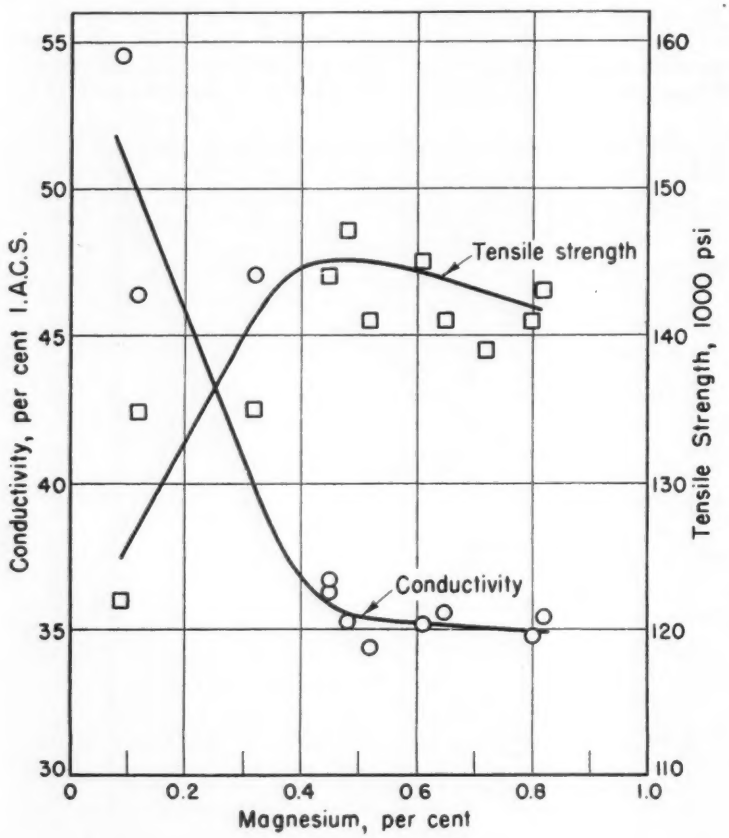
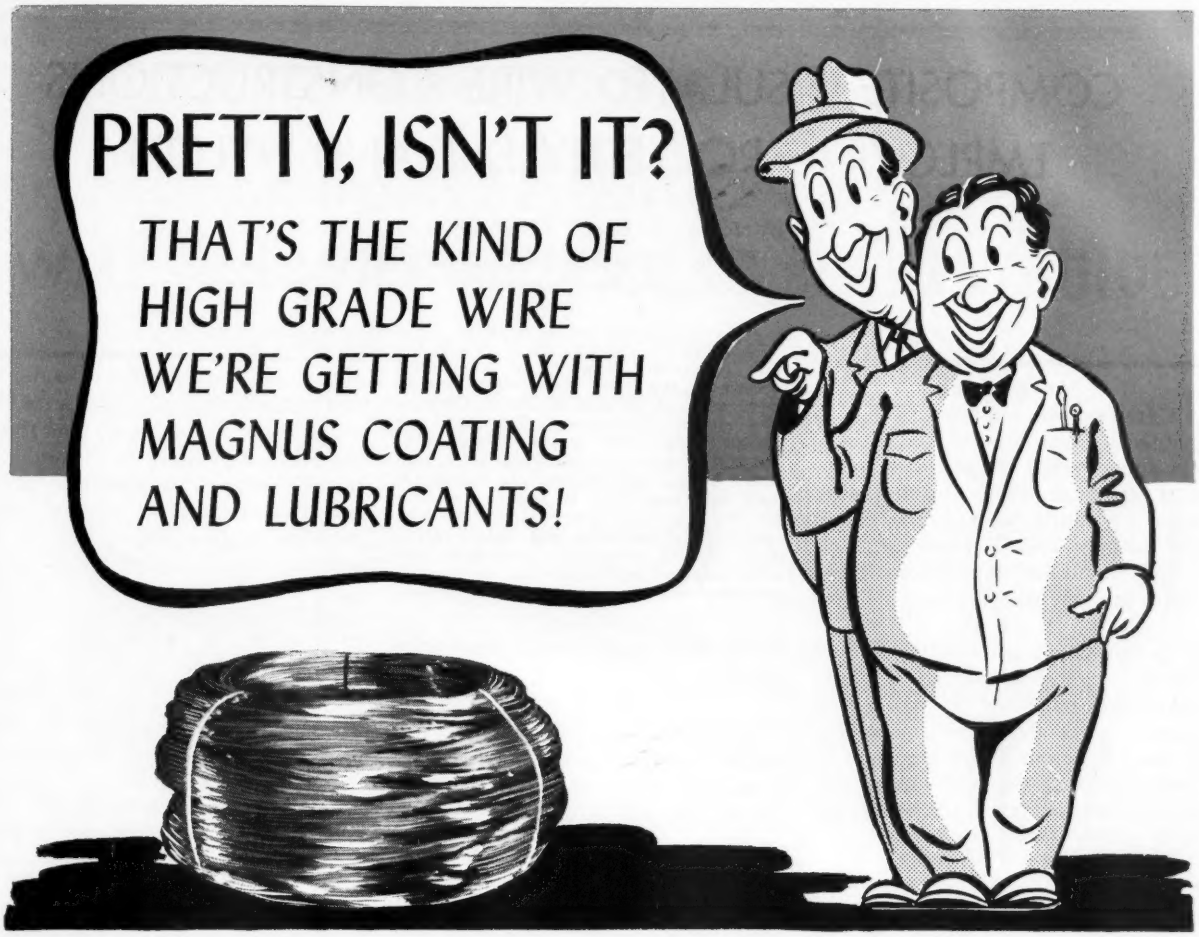


FIGURE 7. EFFECT OF MAGNESIUM ON PROPERTIES OF Cu-Fe-Cr HARD-DRAWN WIRE

17-19 per cent Fe, 2.2-2.4 per cent Cr, balance Cu and Mg-8 B and S gage (0.129") - 96.3 per cent reduction after full anneal



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COMPOSITE INSULATED WIRE CONSTRUCTIONS EMPLOYING POLYETHYLENE AND NYLON

by James E. Flood, Chief Chemist
The Plastic Wire & Cable Corporation
Jewett City, Connecticut

This paper was presented at a technical session of the Wire Association Annual Convention on October 22, 1951 in Chicago. The author discusses coatings used on assault wires with special reference to the WD-1 type, a Signal Corps wire with which he has had considerable experience both in World War II and the present Korean war. The history of the development of polyethylene and nylon resins, their use in composite insulations and some practical applications are covered.

Introduction

Considerable material has been published dealing with the electrical and physical properties of polyethylene and nylon. On the other hand very little has appeared about the history and increase of their use in insulation applications, especially in composite forms.

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In this paper we will touch only lightly on the properties of these resins and endeavor to give a brief history of their development and a general account of the growth of their use in composite insulations, in combination with each other and with other dielectrics.

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We will first discuss polyethylene, follow with nylon and then conclude with a brief account of some practical applications.

Polyethylene

History: Polyethylene was originally developed in Britain by the Imperial Chemical Industries, Limited, about 1933. Its introduction to American industry came in the early 1940's, when the United States Navy arranged for the construction of two plants in the United States to be operated individually by two of our large chemical industries. The entire amount of these two units was at first allocated by the United States Government to cable manufacturers engaged in processing RG/U coaxial cables.

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The development of polyethylene was quite timely, for without it, or some other dielectric having equal or superior electrical properties, air borne radar would have been impracticable. The success of polyethylene in radar and coaxial cables brought it to the foreground, and many other applications were suggested.

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In 1944 the Army Signal Corps obtained allocations of polyethylene for assault wire and toward the close of the war for infantry field wire.

★ ★ ★

With the extensive research facilities of the two licensees, polyethylene was considerably improved, and new and improved techniques of processing were made available to the fabricators. Independent firms also contributed considerably to our know-how by using their laboratories to investigate specific problems.

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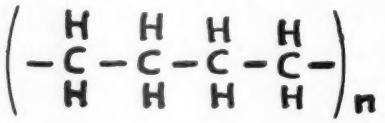
Chemistry: Polyethylene is a thermoplastic resin produced by polymerizing ethylene under high pressure and high temperature in the presence of a catalyst, to form straight-chain essentially saturated polymers of ethylene.



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By controlling the conditions of polymerization, polymers of different molecular weights may be obtained, ranging in physical form from semi-solid to solid. For electrical applications, we are concerned only with polyethylene having a molecular weight of 18,000 to 24,000, as the resins in this range lend themselves to extrusion in the conventional equipment available to industry. The resin in its natural state, prior to adding any pigments for coloring, stabilizing agents, etc., is a waxy-white, translucent, flexible solid.

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Properties: Extrusion grades of polyethylene for electrical applications are inert to practically all types of solvents at room temperature, will retain a dielectric constant of 2.3 and a power factor of 0.0005 with essentially no variation over a wide frequency range. The resin maintains its flexibility to below —70° C, and holds its form up to about 100° C. However, a service temperature of 80° C is considered the upper limit. But the actual top service temperature will vary with individual conditions, such as current, size of conductor, wall thickness, mechanical load, protective coverings, etc.

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Recent advances in the stabilization of polyethylene with certain types of carbon black and other ingredients have resulted in compounds having improved resistance to outdoor weathering.

Nylon

History: Nylon is a product of the research laboratories of the du Pont Company about 1934. Its early uses were in filaments, fabrics and injection molding.

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Workers in the du Pont laboratories at Arlington were the first to recognize the possibilities of nylon as a wire coating. The inadequate

(*Please turn to page* 1081)

NOTICE TO ADVERTISERS • • •

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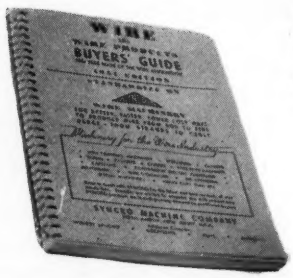

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HOW DEVELOPMENT AND RESEARCH HAVE CREATED NEW MARKETS FOR NICKEL BASE, NICKEL CHROMIUM, AND CHROME IRON ALLOYS

by D. M. Schmid, Vice Pres. and Gen'l Mgr.
Alloy Metal Wire Company, Inc.
Prospect Park, Pennsylvania

In this paper, delivered at the Wire Association Convention in October, Mr. Schmid shows how the production of alloy wires can best be carried on by a small concern and shows how development and research work have been indispensable to them in developing new markets and in rendering the type of service required by users of their nickel alloy wires.
Mr. Schmid graduated in 1937 from the Carnegie Institute of Technology. His experience includes production, engineering, research and technical field work in the metal and chemical industries, the past six years of which have been with the Alloy Metal Wire Company.

This paper explains why both development and production of these alloys can best be done by a small producer.

★ ★ ★

You may have never heard of Alloy Metal Wire Company, a small cold drawing and cold rolling mill located in metropolitan Philadelphia. We will fill an order for ½ pound or a million pounds. We think in pounds where most of you think in tons. You might consider us in the semi-precious metal business in that the average per pound price of our shipments is over $1 per pound.

★ ★ ★

Our size range is as follows:

Monel, Nickel and Inconel wire and rod—½″ dia. down to .0017″
Strip and flat wire up to 3 wide, thickness range .062 to .002″
Almet Stainless Steels ¼″ dia. down to .0017″
Strip and flat wire up to 1½″ wide, thicknesses .040″ down to .005″

★ ★ ★

On the next page are the three families of alloys we manufacture.

★ ★ ★

Like most families, these alloys have some second cousins such as Nickel Clad Copper which is an off shoot of pure Nickel, some special Nickel Iron alloys used for their special magnetic properties, glass sealing properties and other constant modulus properties over special Nickel Iron alloys for their a wide temperature range. Another second cousin is Nickel Plated Iron which has been developed for the electronic industry due to the Nickel shortage.

★ ★ ★

You will find that all of these different types total up to about 75 different alloys. In addition, for many of these alloys we have a number of different analysis. For instance, in Almet 302 and 304 Stainless, we have to have one analysis for spring wire, another for rope wire, still another for weaving wire, another for cold heading wire, and then you get a special analysis still different for magnetic recording wire and armature banding. Since all of these metals have a bright silver appearance, we must have an elaborate identification. Each worker in our plant carries an identification card reproduced here that shows the type of metal tag attached to each coil, identifying it all through the various plant operations from the time it arrives in our raw material stock yard until it gets to the shipping room.

D. M. Schmid, V.P. and G.M., Alloy Metal Wire Co., Inc.

★ ★ ★

Because we make so many different alloys, our customers are assured of unprejudiced advice when they come to us with their problems. For instance, if a customer has a heat resisting problem on .105″ dia. wire used in spiral woven conveyor belts at 2,050° F. in a copper brazing furnace, since we make all the different alloys that are used for this application, we can show him the three alloys that have given the best service and economy record over a period of ten years. They are Inconel, Almet 310, and Almet 314 Stainless.

★ ★ ★

Another example of a corrosion resisting nature will involve a customer handling sodium chloride through the various stages of its manufacture. From the experience, we know that for one stage in the manufacturing process Monel is best. For another stage, Nickel has the longest life.

★ ★ ★

Customers have all kinds of problems and a question that we frequently get is "What is the best metal to use for our particular electrical resistance problems." Chances are we could take good care of this customer's needs because we develop considerable data on most of the metals that may be used for their electrical resistance properties. We can supply a customer with the wire varying in specific resistance from 40 ohms per circular mil foot all the way up to 675 ohms.

★ ★ ★

The position of trust and confidence which we enjoy from the cus-

GUIDE TO ALLOY METAL WIRE COMPANY PRODUCTS

ELECTRICAL RESISTANCE ALLOYS. Designed to meet the most severe conditions of temperature and oxidation, they are most widely used in electrical appliances and industrial heating equipment where long life and uninterrupted operation are of primary importance. They are produced under the latest existing patents and are maintained to standards of quality and life test as prescribed under A.S.T.M. specifications. **(Catalog D-1)**

	NOMINAL COMPOSITION					FORMS PRODUCED			
	Cr.	Ni.	Cu.	Fe	Other	Wire	Rod	Flat Wire	Strip
Alray A	20	80				+	+	√	**
Alray C	15	62		Bal.		+	+	√	**
Alray D	18	35		Bal.		+	+	√	
Excelsior		45	55			+	+	√	
Nickel—Grade A		99+				+	+	√	++
Grade D		94.5			4.5 Mn.	+	+	√	
Grade E		97.5			2.5 Mn.	+	+	√	

‡**INCO ALLOYS.** Widely used in applications where corrosion and heat resistance are of paramount importance and where special properties, such as wear, fatigue, impact and so forth combined with these properties are essential. **Catalog D-2)**

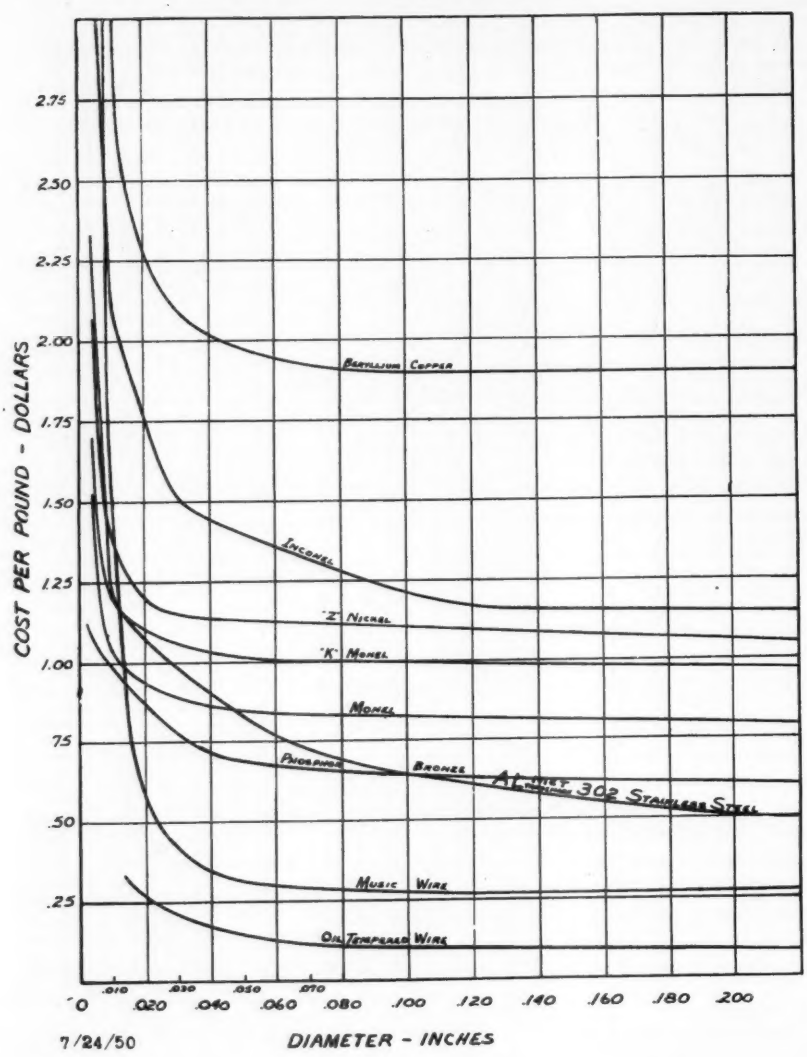
Monel		67	30			+	+	√	++
"R" Monel (Free Machining)		67	30			+	+	√	
"K" Monel		66	29		2.75 AL	+	+	√	++
"KR" Monel (Free Machining)		66	29		2.75 AL	+	+		
Nickel (Grades A, D and E)		See Above				+	+	√	++
Dura Nickel ("Z" Nickel)		94			4.5	+	+	√	++
Inconel	13	80		7		+	+	√	++

STAINLESS STEEL. An opportunity for product improvement and new design in many fields. They also have exceptional qualities in resistance to corrosion and heat. They are obtainable in a number of types and grades, differing in chemical composition, so that a selection may be made to meet the requirements of various specific applications. **(Catalog D-3)**

Almet 302	(Max. .20 Carbon)	18	8		Bal.		•	•	√	**
Almet 303	Free Machining	18	8		Bal.		•	•		
Almet 304	(Max. .08 Carbon)	18	8		Bal.		•	•	√	**
Almet 17-7PH	(Max. .09 Carbon)	17	7		Bal.	Al .75-1.25	•	•	√	
Almet 305	(Max. .12 Carbon)	18	12		Bal.		•	•	√	
Almet 308		20	10		Bal.		•	•	√	
Almet 309		25	12		Bal.		•	•	√	
Almet 310		25	20		Bal.		•	•	√	
Almet 314		25	20			2-3 Si	•	•	•	
Almet 316		18	12		Bal.	2-3 Mo.	•	•	√	
Almet 317		18	12		Bal.	3-4 Mo.	•	•	√	
Almet 330		15	35		Bal.		•	•	√	
Almet 347		18	10		Bal.	Cb.	•	•	√	
Almet C-20	(Max. .07 Carbon)	29	20	3.00Min	Bal.	Si 1.00 Mo 2.00	•	•	√	
Almet 405	(Max. .05 Carbon)	11.5-13.5				Al 10/.30	•	•	√	
Almet 410	(.12 Carbon)	12-14			Bal.		•	•	√	
Almet 416	Free Machining	12-14			Bal.		•	•	√	
Almet 420	(.35 Carbon)	12-14			Bal.		•	•	√	**
Almet 430		14-18			Bal.		•	•	√	
Almet 434		14-18			Bal.	Cu.	•	•	√	
Almet 442		21			Bal.		•	•	√	
Almet 446		25			Bal.		•	•	√	

(‡) International Nickel Co. (+) Max. Size ½" (•) Max. Size ¼" (++) Max. Width 3" (**) Max. Width 1½" (√) All Sizes

Comparative Cost of Spring Wire



tomers who have occasion to use the metals in our size range has resulted from a lot of hard work on our part to solve the problems they have brought to us. Our development engineers who do most of the contacting with our customers ask for such special problems on each contact with our customers and prospects. Only by constantly seeking out the problems which our customers and prospects have has it been possible to create new markets for these alloys.

★ ★ ★

Frequently, customers bring such problems to us for which we have no available alloy; if the market warrants, we will develop some special alloy to serve this need. Some examples of this are Nickel Clad Copper where our customer wanted something with good electrical conductivity and yet the resistance to oxidation of pure Nickel. Tin plated copper which was formerly used for high temperature lead wire on industrial electric heating units as well as electrical appliances would embrittle at temperatures above 250° F. Customers, as a result, use solid Nickel for such high temperature work; but due to the fact that they always had to use the wire five gauges larger when they use solid Nickel, the leads sometimes became large and bulky. As a result, Nickel Clad Copper was developed where 28% of the cross sectional area consists of the Nickel covering and the balance 70% of the cross sectional area is copper. It is only necessary to use one gauge larger Nickel Clad Copper than pure Nickel, which means that for many jobs Nickel Clad Copper is both cheaper than copper or solid Nickel.

★ ★ ★

The electronics industry, in addition to all the other normal specifications that one might encounter, requires that the metal have a minimum of gas content so that the tube will have longer life. For such applications, gas tests must be made on both the starting and end of either the coil or spool and the gas test results attached to the package unit so the customer can compare it with his own test results. The electronics industry also require that metals used on the inside of the tube have high degree of corrosion resistance, heat resistance, good strength at high temperatures, special magnetic properties, and that the metals be weldable and manufactured to close size tolerances along with great uniformity of mechanical properties for ease of fabrication on their extremely high speed precision equipment.

★ ★ ★

Such manufacturing and close control of so many physical properties of our products means that extra supervision is required. This supervision must have good background in the many problems encountered plus extreme flexibility and resourcefulness. It is because of this extreme care and extra quality control that must be maintained on the alloys we manufacture that we believe both the development and production can best be done by a small producer. First of all, many of our customers actually start out using relatively small quantities of our metals. It is nothing for us to average 25 orders per day for quantities under 10 pounds and more than half of our orders are for under 300 pounds, which is the minimum quantity that most of the Stainless Steel producers will accept orders for. This patience and "know how" to help these customers adapt our alloys to their products, results in original orders and repeat orders. An interesting example is scouring sponge manufacturers. They first

experimented back in 1934 and we supplied experimental quantities tor a number of years. Just last year, the volume of Stainless Steel scouring sponges exceeded the volume of copper sponges and is now an attractive piece of business.

★ ★ ★

We have learned by experience that price cutting is not good business. Frankly, we are allergic to selling anything for less than scheduled prices. Whenever some particular piece of business does become cut price, we drop the item and put our efforts to work on a new application that will bring scheduled prices. We have found that if you are going to sell quality, you can't do it at cut prices.

★ ★ ★

While the spring manufacturers have always been an outlet for our alloys, it was not until we put our development and research team to work on developing special alloys and special analyses along with purchase of special equipment about 15 years ago that we were able to give the spring wire manufacturers what they required. We have found that you can't go in and develop a market for your products until you can offer something that can be used on standard equipment. Fabricators will actually make little change in their equipment to adapt it to your alloys. For instance, Stainless Steel is a very galling metal and will not run on a standard spring coiler without some type of coating that serves as a lubricant where the spring wire comes into contact with the forming tools. A number of coatings have been developed such as lead, oxide, copper, and presently development work points towards non-metallic coatings that will not require removal after the spring has been formed.

★ ★ ★

Here is a price comparison chart on the various metals we manufacture that have special interest to the spring manufacturers. Please note that we have shown the comparative cost of music wire along with oil tempered wire. You will note that in sizes under .013" diameter, Almet 302 is cheaper than music wire and this has proven to be a large market to us since the customer can get all of the many advantages of Almet 302 Stainless Steel plus lower costs.

★ ★ ☆

Ten years ago we actually sold very little spring wire for the high temperature applications. When we refer to high temperature spring applications, we are actually talking of anything over 250° because copper base alloys lose their usefulness at that point, where corrosion is involved, Nickel Chromium Iron alloys are almost universally used. Here again, we have alloys to serve the full temperature range from sub zero temperatures where alloys that contain nickel have good impact properties and good ductility. Actually, any steel that does not contain nickel has very low impact properties and poor ductility at temperatures under 0° F. and they can become progressively worse at lower temperatures.

★ ★ ★

Nickel does improve one or more of the properties of material to which it is added—at sub zero and elevated temperatures, and has become an essential component for more than 300 commercial alloys. This is the reason for its short supply today. Most of your armor plate being made today contains a higher then normal percentage of nickel because it has to be made to have good strength at the sub zero temperatures to which it would be subjected in an arctic war.

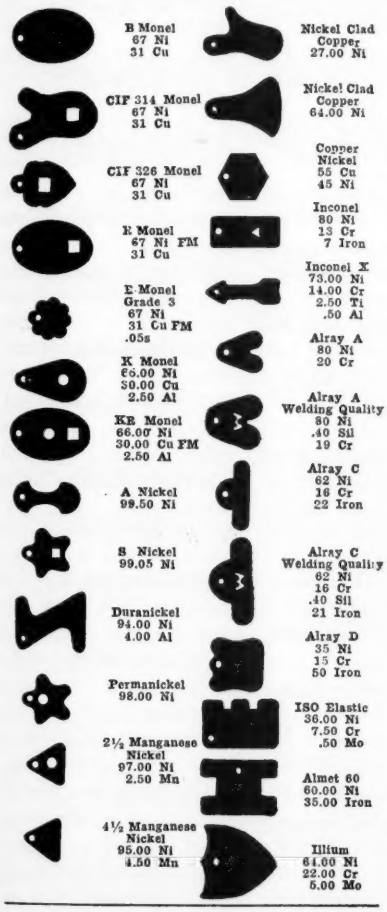
★ ★ ★

At the other end of the temperature range, conditions are even more severe and again we have a number of alloys to serve the high temperature conditions involved. For example, Figure No. 2 shows

ALLOY METAL WIRE CO.

Identification Tags for Different Metals

Be sure every coil and spool is properly identified at all times. Learn to know how to distinguish different metals by their tags.



ALLOY METAL WIRE CO.

Identification Tags for Different Metals

Be sure every coil and spool is properly identified at all times. Learn to know how to distinguish different metals by their tags.

the approximate limiting service temperatures of the more commonly used spring materials.

★ ★ ★

Figure No. 3 below shows the comparative relaxation of springs at elevated temperatures. You will note the curves show the stress and temperature required to produce 6% load-loss after seven days. You will note that music wire falls off rapidly at the temperature of boiling water; phosphor bronze and berylium copper also lose their spring properties at boiling water temperatures, chrome vanadium steel (the best of the alloy steels) is about 400° F., you will note from the curve that Type 302 Stainless loses its spring properties fast at 500° F. Inconel and "Z" Nickel maintain good spring properties at 650° F. From the curves, you will note that Inconel "X" has the best resistance to relaxation.

★ ★ ★

The spring coilers and design engineers have found ready use for Inconel and it is now extensively used in all types of thermostats, electrical appliances, steam and power generating equipment.

★ ★ ★

An interesting example is The Electric Auto Lite spark plug where Inconel is used for contact springs because it will maintain constant spring tension and not relax at the high operating temperatures of 600° F. Even though this is a small spring and there are thousands to the pound, the quantities of spark plugs made are so terrific that thousands of pounds of Inconel wire are used for this application.

★ ★ ★

Inconel "X" even though only commercially available in wire sizes for the past six years has already found widespread use on aircraft break drum springs operating at temperatures up to 750 and 800° F. Likewise, it finds application on diesel engine injector springs operating at 700° F. Jet engines, atomic energy and various other defense projects involving high temperature applications are making extensive use of Inconel "X" for springs. Much patience and a lot of money was spent in making Inconel "X" commercially available in wire form and only now has our investment

INDICATED MAXIMUM SAFE OPERATING TEMPERATURE FOR SPRINGS AT ELEVATED TEMPERATURES

MATERIAL	MAX. SAFE TEMP. °F
MUSIC WIRE	175
PHOSPHOR BRONZE,	225
BE COPPER, H.T.	225
MONEL, Str. Rel. 575-650/1Hr.	400*
CARBON STEEL	400
CR-V STEEL	425
13% CR (414) STAINLESS, H.T.	450
"K" MONEL, Aged 980/6Hr.	450*
18-8 (302) STAINLESS, S.R.	500 to 550
"Z" NICKEL TYPE B, Aged 690/4Hr.	550
18-2 (431) STAINLESS	600 to 650
"Z" NICKEL, Aged 980/6Hr.	650
INCONEL, Str. Rel. 850-900/1Hr.	650
HIGH SPEED STEEL, H.T.	800 to 850
INCONEL "X" [illegible] Temper Wire, Aged 1200/4Hr.	700 to 800*
INCONE[illegible] Temper Wire, Aged 1350/16Hr.	850*
INCON[illegible] Temper Wire, Aged 1350/16Hr.	1000**

* NOT GENERALLY RECOMMENDED FOR ELEVATED TEMPERATURE. RELAXATION IS PROGRESSIVE WITH STRESS, TEMPERATURE AND TIME.

* Spring Temper and Aged above 700° recommended only for short time at stress and temp the prototype items above 800° use Hard Temper Wire

* For MAXIMUM resistance to creep or load loss up to 850°F. load hard by stamping (after coiled and aging) at a deflection corresponding to a stress 10% above max. operating or load stress and hold for 1 Hr at a temperature of 100° above max. operating or test temperature

** As an alternate treatment for service temp above 850°F. the following alternative heat treatment is suggested: Over age at 1650°F/2 Hr. drop furnace to 1300°F and hold at this aging temp for 16 Hr 1 hr air cool after 1650°F and then age at 1300°F / Note: On all INCONEL "X" aging treatments - furnace or air cool. No significant difference.

TORSIONAL MODULI OF NICKEL-ALLOY SPRING WIRES AT ELEVATED TEMPERATURES

TEMPERATURE °F	TORSIONAL MODULUS, PSI		
	Monel "K" Monel	"Z" Nickel	Inconel and Inconel "X"
70	9,500,000	11,000,000	11,000,000
200	9,300,000	10,800,000	10,800,000
300	9,150,000	10,620,000	10,600,000
400	8,950,000	10,450,000	10,400,000
500	8,750,000	10,220,000	10,160,000
600	8,500,000	10,000,000	9,900,000
700	8,200,000	9,750,000	9,650,000
800	7,950,000	9,450,000	9,350,000

Fig. 2

started to make a profit.

★ ★ ★

Inconel "X" is a good example of how the properties of some of these special alloys are so much different from what you might think. For instance, you normally think of an alloy having best spring properties when it has been cold reduced about 75%. This is true of Inconel "X" for its room temperature spring properties. However, its spring properties at elevated temperatures are much better when the wire is in the soft annealed condition or what we call "one hole hard temper." You will actually note that in Figure No. 2, Inconel "X" No. 1 temper or one hole hard temper is used at temperatures up to 850° F. whereas the spring temper is only used at 700° F. Considerable

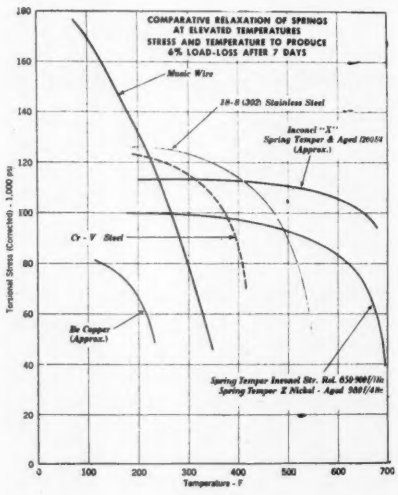


Fig. 3

experimental and development work plus many field trials were required to find out just what temper of Inconel "X" developed the best spring properties at temperatures above 700° F. Such testing is expensive and at this point I would like to comment that the alloys being developed today are more intricate and require more time and money to develop into commercial products than was ever needed for the alloys we were making five or ten years ago. This is natural in an industry that is becoming more advanced, for problems naturally get more complex. Naturally, when we get into such involved research and development programs, our research, production and stockholders complain about the time and money required. My reply to this is that "You can all be glad that we have such tough problems in connection with the uses of our alloys and that our customers have fussy specifications, because that is the very reason for our company's existence. If our alloys were simple to manufacture and easy to sell, then the big steel companies would have taken over our business long ago and they could make our alloys in the same plants where they produce fence wire and other easy-to-make products."

★ ★ ★

Another heat resisting application that we all have a lot of fun over is the wire brassiere. This is an application that we are always hoping we will get some complaints on for field investigational work. The .072" diameter Type 302 Stainless Steel wire with 250,000 psi tensile has been used for this application and over a three to four year period, ½ million pounds have been used.

★ ★ ★

We have an alloy known by the name of "ISO Elastic" which is approximately 40% Nickel Iron that has a constant modulus over a wide temperature range and is used for scale and instrument springs. To get the desired properties, it must be given exactly 93% reduction. Due to the short coils in which the hot rolled rods are supplied plus the nature of the alloy, it can only be drawn one hole at a time

(*Please turn to page* 1074)

Improvements in Cable Lacquers Through the Years

by Joseph S. Hawes, Manager, Cable & Coatings Division
New England Lacquer Company
East Providence, Rhode Island

The importance of lacquer in the manufacture of insulated wire is now well established. Lacquer contributes greatly to the value of finished wire because of the protection, identification and attractiveness is provides.

★ ★ ★

But the advantages of using lacquer as a cable coating have not always been taken for granted. As we all know, it was less than one hundred years ago that conductors in the electrical field were comparatively simple. Consequently, they needed no exterior protection. Because of the limited applications at that time, the wire construction itself was adequate without outside coating.

★ ★ ★

As the needs of civilization became more complex, however, a change took place. Communication systems became more complicated; wiring systems became more involved. As a result, greater and greater responsibility was placed on the wire which formed the core of modern electrical systems. The burden of keeping up to date on new wire specifications and producing wire to meet current needs, fell on the shoulders of wire manufacturers. Ever since these early days of manufacture, wire producers have been forced to keep constantly alert to new ways of improving their wire products to meet changing requirements. It was under these circumstances that the value of lacquer cable coatings as a means of meeting many of these new requirements was quickly realized, and in our modern world of technicalogical advances—the vital role of lacquer in the wire industry is even more firmly established.

★ ★ ★

Let's look briefly into the history of cable coatings and see how well lacquer has kept pace with changing wire requirements. Aside from the historical value of such a study it will also help to emphasize one important point—namely that lacquer for the wire industry is not a standard commodity (such as paint, enamel, etc.). Instead, it is a chemical mixture which must be ever changing to keep pace with new requirements demanded of it.

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Most wire specifications call for a lacquer which must be specially formulated for **one** particular job. Because of this situation, the entire lacquer producing industry has geared itself to an ever-changing experimental atmosphere. That is the reason lacquer producers have been able to give considerable aid to wire manufacturers in helping them meet changing wire specifications. A study of the history of cable coatings clearly illustrates the lacquer industry's constant search for new and improved wire coatings.

Mr. Hawes was born in Seekonk, Massachusetts, in 1917. He has been employed by the New England Lacquer Company since 1938, except for his Army service years, first as a laboratory apprentice and later as a full-fledged research chemist.

He developed and perfected New England Lacquer Company's complete line of coatings for braided wire. He now handles both sales and field developments of the cable lacquer division of the New England Lacquer Company.

Mr. Hawes delivered this paper at The Wire Association Convention in Chicago on October 23, 1951.

★ ★ ★

Now let's trace the major lacquer developments up to the present day to evaluate the progress made through the years.

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The first use of lacquer, according to duPont and Hercules, dates back to 1870, a few years after the Civil War. This original cable coating was used to protect wire by preventing cotton servings from ravelling and soiling.

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We do not believe that we are divulging any of our very valuable and secret formulae by stating before this open meeting that this first lacquer mixture consisted of nitrocellulose cotton and castor oil. The technique of mixing nitrocellulose and castor oil was well known in the pyroxylin field and it did not take a great deal of imagination to transfer this coating and adapt it to coating over braided wire.

★ ★ ★

The common material used for many years consisted of one part of nitrocellulose, 1½ parts of castor oil carried in the fastest usable solvents in order that the material could be applied over the braid in the speediest and most economical manner.

★ ★ ★

Although this type of lacquer is no longer suited for many modern day requirements, it still has several present day applications. In fact, some current manufacturing uses are served most economically, efficiently, and advantageously by the

nitrocellulose-castor oil type of formulation.

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As new materials became available, however, and as new standards and specifications became more severe, nitrocellulose lacquer became unsuitable for many uses.

★ ★ ★

Wire manufacturers were beginning to use colored tracers in the wire braid in order to identify circuits and improve the appearance of assemblies. Consequently, they needed a coating which would give greater protection to the construction. Yet the keen competitive situation would not allow an appreciable increase in wire costs due to higher costs of an improved lacquer. Ethyl cellulose proved to be the answer. It inherently possessed good resistance to discoloration by sunlight and its use in cable coatings was thought to make possible a reduction in the price of finished coatings.

★ ★ ★

Most types of ethyl cellulose are soluble in an alcohol-hydrocarbon mixture which is usually less expensive than the solvents used in nitrocellulose coatings. Nitrocellulose is soluable only in a mixture of so-called active solvents, esters, and ketones, latent solvents such as the alcohols, and diluents in the order of the hydrocarbons, aromatics, or aliphatics.

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Because of this, it seemed that we would be able to make an ethyl cellulose coating with superior performance properties at less than the price for nitrocellulose coating. If this were true, the introduction of ethyl cellulose to the wire industry naturally would meet a minimum of resistance. Unfortunately, it did not work out exactly that way. Due to the initial softness of ethyl cellulose, we were not able to incorporate as high a ratio of plasticizer to cellulosic resin as we were able to do in the case of the nitrocellulose coating The lower ratio which was necessary meant that the cost would have to go up. The plasticizer addition was not only a means of obtaining required flexibility and resistance to materials such as hot oil, but was also a means of lowering the cost of the film. Incidentally, if you have an occasion to glance at plasticizers available on the market today, you will soon realize that there is very little difference in price between the basic film former, as we term it, and the plasticizers.

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After considerable effort, by coating formulators, wire manufacturers and suppliers of anti-oxidants and accelerators to the rubber trade, an ethyl cellulose coating was developed which met most requirements yet cost no more than previous coatings. It possessed initial and extended resistance to discoloration caused by sunlight and primary insulation. In addition, the ethyl cellulose type of coating imparted to the final wire construction a moderate degree of flame resistance. By this we are not implying that it is not possible to have a flame resisting nitrocellulose coating, but to do so using nitrocellulose as the basic film former would probably be more expensive.

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Cable coatings which have the ethyl cellulose type of construction are now used widely by the automotive trade for primary wire and high tension ignition cable where coating is still used in the construction.

★ ★ ★

The excellent resistance of this coating to heat and hot oil meet standard requirements very readily. Lacquer producers have continued work on the development of the ethyl cellulose type of coating and at the present time ethyl cellulose coatings are available which not only resist discoloration due to sunlight but also accelerators and antioxidants used in rubber stocks.

★ ★ ★

In addition, this newer type of coating has an improved resistance to heat in the order of 325° F. for extended periods of time without noticeable loss of flexibility, gloss, or weight. The exact characteristics of ethyl cellulose coatings, however, depends on the lacquer supplier's

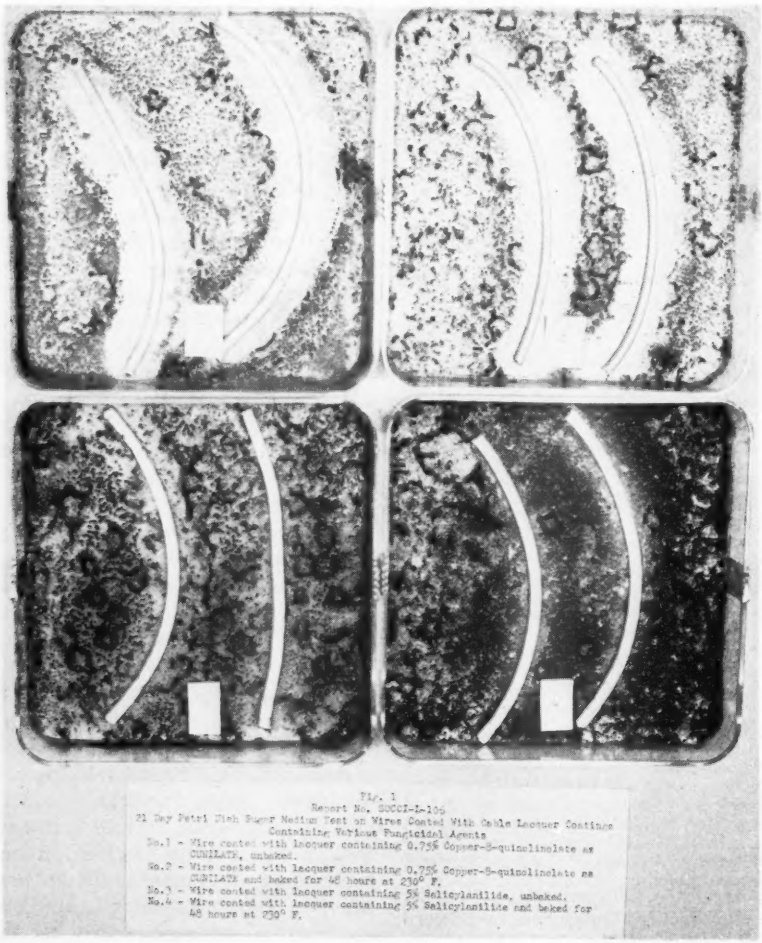

Fig. 1
Report No. 3UCCI-L-106
21 Day Petri Dish Fungus Medium Test on Wires Coated With Cable Lacquer Coatings Containing Various Fungicidal Agents
No.1 - Wire coated with lacquer containing 0.75% Copper-8-quinolinolate as CUMILATE, unbaked.
No.2 - Wire coated with lacquer containing 0.75% Copper-8-quinolinolate as CUMILATE and baked for 48 hours at 230° F.
No.3 - Wire coated with lacquer containing 5% Salicylanilide, unbaked.
No.4 - Wire coated with lacquer containing 5% Salicylanilide and baked for 48 hours at 230° F.

knowledge of compounds used and the skill with which the lacquer is formulated.

★ ★ ★

The advent of World War II was primarily responsible for the rapid development of a new group of lacquer components which are still in common use today. They are acetate butyrate, acetate propionate, and cellulose acetate. The needs of modern war equipment demanded that wire coatings possess greater degree of flame resistance as well as the other properties which had been required up to this point. Many of you may recall that reels of wire became sticky with aging after the wire had been lacquered with certain types of lacquer used up to the beginning and during the first year of World War II when the shift was made to polyvinyl chloride insulation. This condition seemed to become progressively worse due to continued migration of plasticizer in a compound.

★ ★ ★

The new war requirements made it quite apparent that cable coating manufacturers had an important task ahead—the job of quickly developing improved lacquers to meet radically different specifications. After a great deal of laboratory research, it was decided to use cellulose acetate propionate as a newer type of basic film former. By incorporating plasticizers, we were able to improve tremendously the degree of tough flame resistance of the complete construction as well as to present a glossy, attractive coating. And by the addition of the necessary fungicides, either pentachlorophenol or salicylanilide, we were able to meet specifications such as AN-J-C-48a covering low-tension, air-craft wire.

★ ★ ★

But then a new set of problems were given to the lacquer industry.

★ ★ ★

New improvements were made on the basic insulating compound: braided constructions were varied and improved; electrical equipment became more complex. The result was that cable coating requirements became much more rigid and complicated. More and more research work was necessary to improve available coatings. To add to the difficulties, about this same time, cellulose acetate propionate became unavailable for normal use to most companies. Efforts were immediately made to replace the now unavailable propionate with cellulose acetate butyrate, and in an amazingly short time, a comparable coating was developed. With the use of polyvinyl chloride type of insulation increasing appreciably month by month, problems increased proportionately, and it was soon discovered that the older type of cellulose acetate propionate and acetate butyrate coatings were raising havoc with the insulation resistance of the wire construction.

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This was undoubtedly due to at least two reasons, one being the solvent combination necessary to dissolve the available butyrate and, secondly, the choice of plasticizers in the lacquer coating film in relationship to the plasticizers used in the basic insulating compound. Experimental work was first started on dissolving an acetate butyrate in solvents that would not noticeably effect the primary insulation and still be adaptable to the laying down of an acceptable lacquer coating. This work also overcame the troubles that had been encountered occasionally when a cellulose acetate type of rayon braid was being used. As you know, solvents in the order of the ketone family would dissolve the celanese braid when the lacquering operation was stopped to enable the operator to re-wire his tower, change spools, or for one of the many other reasons why lacquering systems are closed down occasionally.

★ ★ ★

After overcoming the initial upset of the wire balance in this manner, the problem of plasticizer migration from the lacquer film down into the primary insulation or visa-versa was studied. As a result of the concentrated research work, coatings were developed which, not only allow the

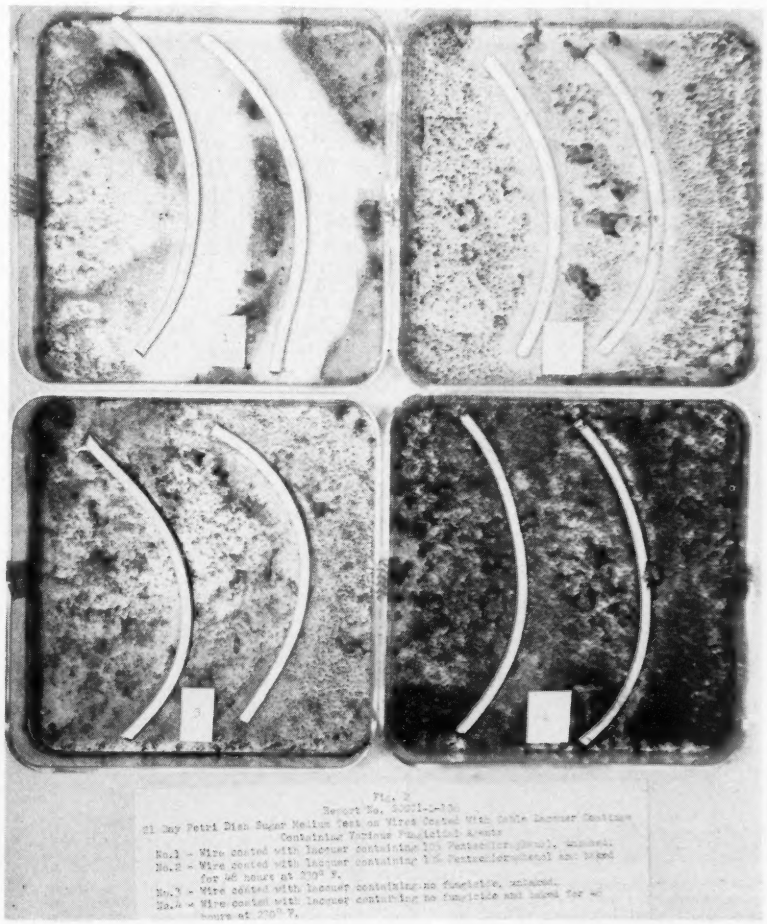


Fig. 2
Report No. 5001-L-10
21 Day Petri Dish Sugar Mellon Test on Wires Coated With Cable Lacquer Coatings Containing Various Fungistical Agents
No.1 - Wire coated with lacquer containing 1% Pentachlorophenol and baked for 48 hours at 200° F.
No.2 - Wire coated with lacquer containing 1% Pentachlorophenol and baked for 48 hours at 200° F.
No.3 - Wire coated with lacquer containing no fungicide, unbaked.
No.4 - Wire coated with lacquer containing no fungicide and baked for 48 hours at 200° F.

Research departments of lacquer producers offer assistance to wire manufacturers in solving specific cable coating problems. * * * * * *

maintenance of initial insulation resistance values, but, in some cases, improve the wire construction. This was accomplished by maintaining a higher insulation resistance value after the tests as compared to control wires run alongside using the same primary insulation without a lacquered braid. It was most interesting to note in going over the results of these tests, that on certain types of coatings—basically cellulose acetate butyrate with a varied plasticizer combination—the control wire had a corrected reading of approximately 3,800 megohms per thousand feet.

★ ★ ★

The coated wire, after aging for three weeks and being put through the twenty-hour immersion in water at 15.5° C., had an insulation resistance reading that was in the order of 30 megohms per thousand feet. Upon checking after a seven-week period, the insulation resistance value was negligible. By comparison, one of the coatings that is now being used had the following effect on the same compound that initially read 3,800 megohms per thousand feet.

★ ★ ★

After going through its initial characteristic downward curve and then recapturing, the insulation resistance rose to a high of approximately 5,300 megohms per thousand feet and a fairly comparable high figure has been maintained for a long period of time.

★ ★ ★

We would like to suggest to present and prospective testers of coatings that when these lacquers are to be used over PVC insulation, and insulation resistance retention is a requisite, the test periods should be carried **beyond** the point where you feel reasonably certain solvents have evaporated completely. Here is the reason for this suggestion:

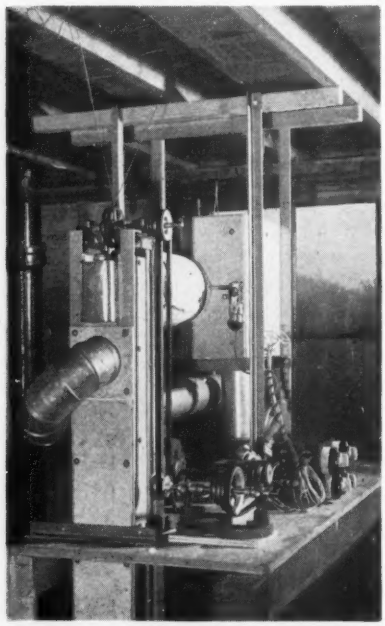
★ ★ ★

Many times a wire construction with, let us say, a cellulose acetate butyrate coating has passed the required tests after drying and after aging for two or three weeks. Upon checking at different times up to three months later, we have found that the wire construction that initially passed all requirements was now **valueless** as far as the insulation resistance was concerned.

★ ★ ★

The wire used in these tests consisted of braided wire manufactured without a saturant of other formulation. Wire construction was also limited to straight PVC insulation with braid glass, cotton, or rayon. We do not wish to imply that coatings made using acetate butyrate and ketone solvents will not meet certain

(*Please turn to page* 1091)



New lacquer developments are tested thoroughly on pilot lacquer tower (above) which duplicates actual plant lacquering operations.

Joseph Hawes holding wire, author of this article, discusses a lacquer problem with associates at New England Lacquer Company.

Fractional distillation of solvents—one of the control tests used in the manufacture of present-day lacquers. * * *

Catalytic Combustion of Atmospheric Contaminants in Effluent From Wire Enameling Ovens

by Alexander E. Goss
Senior Industrial Hygiene Chemist
Bureau of Industrial Hygiene
Connecticut State Department of Health
Hartford, Connecticut

This investigation in the use of catalytic combustion of the effluent from wire enameling ovens indicates that there can be considerable reduction of the atmospheric contaminants and combustible materials. The general method of catalytic combustion should have possibilities for use in the field of atmospheric pollution control wherever the contaminants are combustible or readily oxidized to less irritant compounds.

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Each installation should have chemical and physical tests made on the oven and stack effluents in order to determine the optimum operating conditions and verify the reduction of the contaminants that are the source of the atmospheric pollution problem. A minimum of instrumentation should be required for indicating the continued activity of the catalyst.

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During the past year, the **Bureau of Industrial Hygiene,** Connecticut State Department of Health, in cooperation with the **Bureau of Sanitary Engineering***, has investigated the operation of a new method for atmospheric pollution control, CATALYTIC COMBUSTION[2]. The effluen from wire enameling ovens contains several ingredients which are irritating even in small concentrations. This creates an atmospheric pollution problem for the manufacturer of enameled wire, especially when the plant is located in the vicinity of a residential area. This report will show the importance of chemical and physical tests on the stack effluent of each installation and the value of instrumentation for indicating the continued operation of the catalytic action.

Wire Enameling Operations

Enameled wire is used in large quantities by the electrical industry in the manufacture of electrical apparatus, instruments, radios, television, coils and many other electrical appliances. The wire consists of a single strand of copper wire covered with a thin film of natural or synthetic enamel. The wire enameling oven consists of several feed and take-up reels, sheaves, a trough, open container or applicator for the enamel and the drying or baking oven. The ovens are horizontal or vertical and are usually heated by gas. The wire may pass through the enamel several times, being baked in the oven after each passage through the enamel, until the desired thickness of film is attained. This investigation of catalytic combustion of the atmospheric contaminants in the effluent from wire enameling ovens was made on vertical ovens, gas heated, and handling large size wire.

A digest of this paper was given at the Annual Convention of the Wire Association in October by C. A. Litzler, President, Industrial Ovens, Inc., as a written discussion to the paper on the same subject presented by R. J. Ruff, President of the Catalytic Combustion Corporation.

The subject is most timely due to the pressure being put on electric wire manufacturers to eliminate objectionable fumes from enameling operations. The conclusions arrived at indicate the process discussed, if properly engineered, will not only accomplish the objective, but effect operating savings.

Mr. Goss holds a B.S. degree in Chemical Engineering from the University of Michigan. Since 1933 he has been concerned with the problems of industrial hygiene and atmospheric pollution, working for the Health Section, U. S. Bureau of Mines, Pennsylvania State Dept. of Health, Harrisburg, and his present connection with the State of Connecticut.

As the enameled wire passes through the heated oven, the solvents and other ingredients or by-products vaporize, leaving the baked film on the wire. The effluent leaving the top or exit end of the oven is collected by a hood, which has mechanical exhaust ventilation, and then exhausted to the outside atmosphere. The roof of a wire enameling plant is characterized by numerous small stacks, each emitting a white vapor. The stack effluent contains: products of combustion, water vapor, organic solvents, aldehydes, phenols, particulate matter which is mostly the resin base of the enamel and other compounds or ingredients not identified in this investigation. In this report, the effluent from the wire enameling oven, before it reaches the catalyst, will be designated as the oven effluent. The effluent, after passing through the catalyst, will be designated as the stack effluent.

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The enamels used during the operation of the catalytic installation under investigation were: oleoresin, a natural base enamel; formvar, a synthetic enamel of the phenol-formaldehyde type; and nylon enamel.

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A wire enameling company in Connecticut requested the Connecticut State Department of Health to investigate the operation of their catalytic combustion installation. This company had installed catalytic units on two separate wire enameling ovens as experimental or trial units. For many years, the oven effluent from the wire enameling process had been creating an atmospheric pollution problem. From the beginning the company had installed, at great expense of initial and maintenance cost, mechanical

***Atmospheric pollution problems are investigated by the Bureau of Sanitary Engineering. The technical services of the Bureau of Industrial Hygiene are utilized whenever necessary.**

[2]Catalytic Combustion Corporation, Detroit, Michigan.

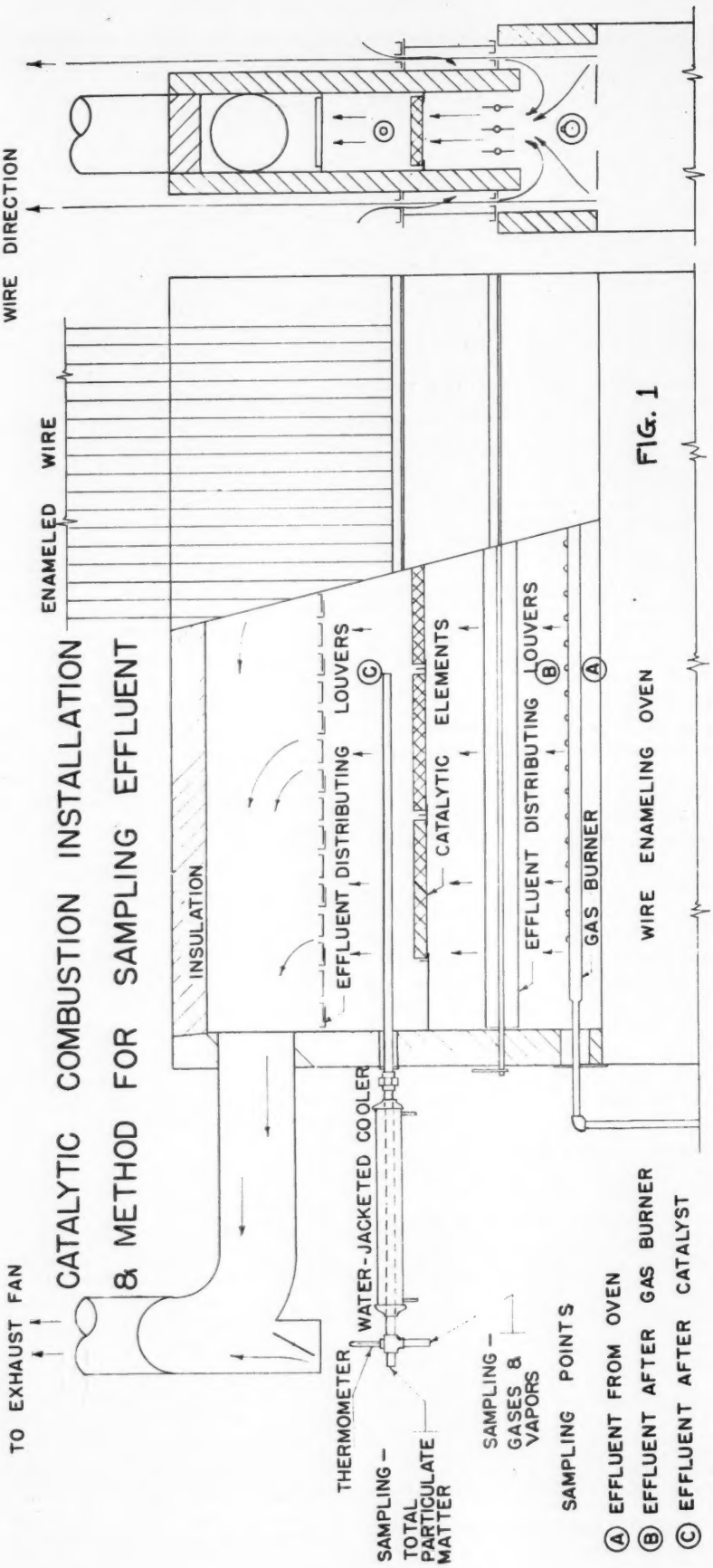

FIG. 1

exhaust ventilation so that the working conditions within the plant met all requirements of the Connecticut State Department of Health. The company had explored various methods for the reduction or elimination of the contaminants in the oven effluent. The methods considered for the control of the atmospheric pollution problem were: water wash, chemical or solvent wash, combustion incineration, electrical precipitation and atmospheric dilution. Control methods, which had been considered in past years, were rejected or abandoned because the method appeared to be impractical, the initial costs of the installation would be exorbitant, maintenance expense would have been excessive or the method would not reduce the concentration of all the contaminants.

Principle of Catalytic Combustion

Catalytic combustion, a recently developed method for the control of atmospheric contaminants in the effluent from wire enameling ovens, was considered as a possible solution for the problem at this plant and at the same time it was believed that the costs would not be prohibitive. Experimental units were installed in order to study the efficiency of their contaminant reduction and economy of operation. An extended period of experimentation will be required in the application of this method of control because little published data are available, changes in the operating conditions, and changes in the construction of the catalytic combustion installation can only be made when the wire enameling ovens are idle for cleaning.

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Catalytic combustion is based on the chemical and physical principles of the phenomenon called catalysis. If a reaction between two or more substances is accelerated by the presence of a third substance (catalyst) which itself shows no ultimate chemical change during the process, it is called catalysis or a catalytic reaction. As an example: hydrogen and oxygen do not combine to any great extent at room temperature but in the presence of platinum powder, the reactants unite instantaneously to form water. In the case of the effluent from wire enameling

ovens, which is essentially organic hydrocarbons with contaminants, the catalyst accelerated the reaction between the hydrocarbons and oxygen to form water and carbon dioxide. In the presence of the catalyst, this exothermic reaction takes place when the reactants are at an initial temperature of approximately 260°C (500 F). The other organic compounds or combustible material will be oxidized to different chemical composition or incinerated, dependent upon the temperature rise at the catlyst. The temperature rise is in direct relation to the potential heat energy content in the oven effluent.

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Theoretically, the catalyst should have infinite life because it remains unchanged chemically during the catalytic process. In actual practice however, the catalyst may have to be reactivated due to the deposition of non-combustible material on the active catalytic surface. Some volatile metals such as, zinc and mercury, will cause the catalyst to become inactive in a very short time.

Description of Installation

The construction of the catalytic unit depends upon the design of the wire enameling oven. In respect to the installation under investigation, each oven was capped with a steel fabricated rectangular box, approximately 2 feet wide, 3 feet high and 8 feet long. This hood was insulated and attached to the wire enameling oven so that the only openings were the slots where the enameled wire left the oven. At one end of the hood was the exhaust outlet which was connected to a blower and the stack effluent exhausted to the outside atmosphere. Inside the hood are the gas burner (used to maintain the oven effluent at 260 C (500 F)), oven effluent distributing louvers, the catalytic elements and the upper distributing louvers. The interior of the hood was constructed of black sheet iron, steel or steel alloy. (See Figure 1).

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The catalytic element has the appearance of a metallic air filter mat. (See Figure 2). The catalyst proper is of the platinum-group, supported on a heat-resistant alloy ribbon. The catalytic elements tested were 1¼ and 2½ inches thick and had an effective area of 1.21 square feet. Each of the installations had four catalytic elements. The construction of the catalytic elements permits high catalytic surface, effluent diffusion and low resistance to air flow. The pressure drop through the catalytic element is less than 0.25 inches of water.

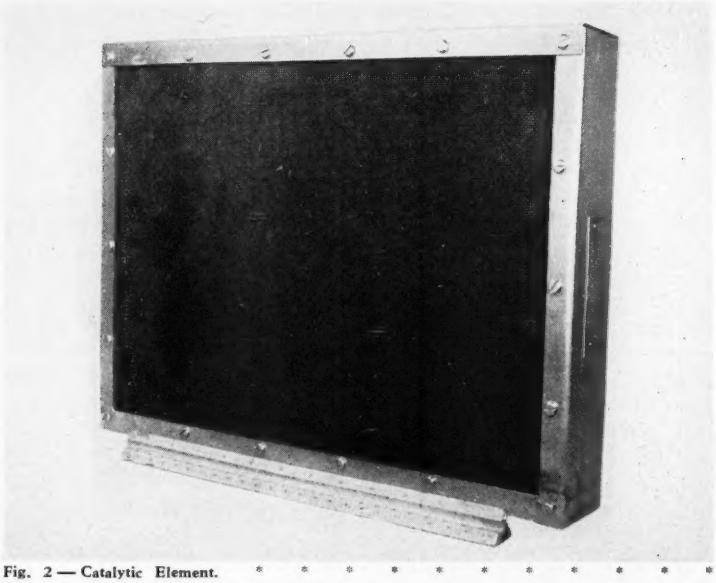

Fig. 2 — Catalytic Element.

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When this installation was first observed the stack effluent was invisible from the ground and the assumption was made that the catalyst was functioning. It should be noted that after the stack effluent left the hood, a bleeder connection was placed in the piping so that the exhaust blower would not influence the temperature conditions within the wire enameling oven and upset the heat balance, thereby producing enameled wire of inferior quality which would have to be scrapped. The dilution of the stack effluent by this bleeder could have accounted for the invisible stack effluent as viewed from the ground. It was later found that this condition was due to the stack effluent being

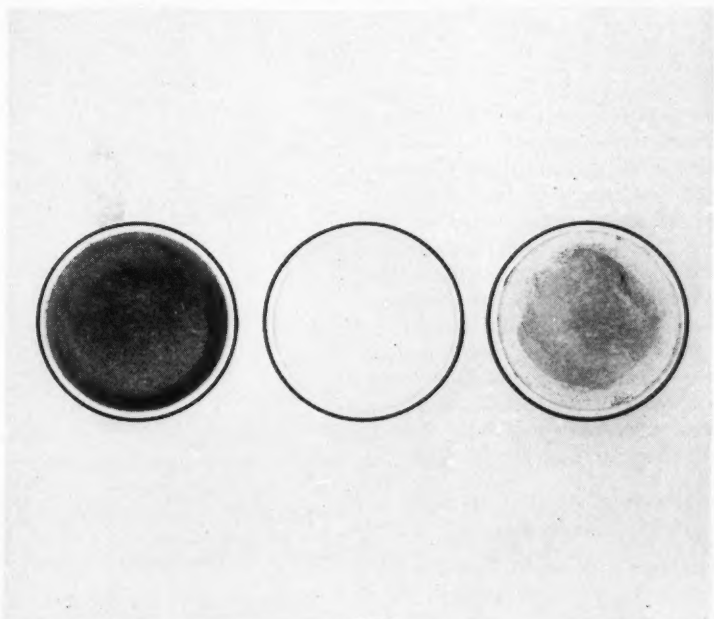

Fig. 3 — Total Particulate Matter Test Papers

Oven Effluent | Test No. III Blank | Stack Effluent

at a temperature of approximately 190 C (375 F), considerably above the boiling point of water. It was then decided that it might be advisable to make certain chemical and physical tests for the contaminants in the oven and stack effluents in order to judge the efficiency of the catalytic combustion installation. These tests included: total aldehydes, total phenols, combustible gases, total particulate matter and temperature rise at the catalyst. Due to the high temperature of the oven and stack effluents, 260 C (500 F) and 482 C (900 F) respectively, the sampled effluents were first passed through a water jacketed-cooler before collection.

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The water-jacketed cooler consisted of 7 feet of ¾-inch black iron pipe, surrounded by 2 feet of water jacketing about one foot from the sampling end. The sampling pipe extended 4 feet into the hood, reaching the center of the wire enameling oven. Figure 1 shows the essential features and various locations at which the water-jacketed cooler was placed for sampling the contaminants. Point A, effluent from wire enameling oven; Point B, oven effluent after passing through the gas burner; Point C, stack effluent which is the oven effluent after passing through the catalyst. The water-jacketed cooler reduced the temperature of the sampled effluent to below 38 C (100 F).

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Due to the fact that few, if any, investigations have been reported of actual operating conditions of catalytic combustion of wire enameling oven effluent, the methods for sampling and determination of the contaminants will be given in detail. No attempt was made to separate the various contaminants or determine the absolute quantitative value of concentration. The various tests were chosen in order to obtain the relative decrease of contaminants due to the catalytic combustion.

Methods of Collection and Analysis

Collection of Sample. For the collection of the gases or vapors, after passing through the water-jacketed cooler, the effluent was passed through 10 grams of 20 mesh silica gel. The sampling rate was 2-3 liters per minute for a period of 20-30 minutes. The silica gel was returned to the laboratory and steeped in 100 ml. of distilled water, preferably overnight. This extraction was then tested qualitatively for aldehydes and phenols and if present, quantitative determinations were made.

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Total Aldehydes. Qualitative Test: Schiff's Reagent[3]. To prepare Schiff's Reagent, dissolve 0.2 grams of rosaniline (basic fuchsin) or an equivalent weight of its salt, in 120 ml. of hot water. Cool and add this solution to 20 ml. of a 25% sodium bisulfite solution. Then add 2 ml. of conc. hydrochloric acid and dilute to a total volume of 200 ml. To render this reagent almost colorless, add a small amount of decolorizing or activated charcoal, shake for a few minutes, filter. The reagent will not deteriorate appreciably if stored in a refrigerator. To 10 ml. of the water extraction, add 1 ml. of Schiff's Reagent and mix. A pink to violet-red color indicates the presence of aldehydes.

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Quantitative Determination: Schiff's Reagent[3]. Standard solution of formaldehyde. Dilute 10 ml. of formalin (formaldehyde solution) with 400 ml. of water. To 5 ml. of this solution add 40 ml. of 0.1 N iodine solution. Then add dropwise, conc. sodium hydroxide solution until the solution turns a pale yellow. Let stand for 10 minutes acidify with conc. hydrochloric acid. Titrate with 0.1 N sodium thiosulfate, adding starch solution near the end of titration. Titrate, in similar manner, 40 ml. of the 0.1 N iodine solution. Subtract the two titrations and from the equation: 1 ml. of 0.1 N iodine solution equals 1.501 mgs. of formaldehyde, calculate, in milligrams, the formaldehyde present in each milliliter of the stock solution. Make a standard formaldehyde solution by diluting the required amount of the stock solution so that 1 ml. equals 0.01 mgs. of formaldehyde.

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To 10 ml. of the water extraction and standards, add 1 ml. of the Schiff's Reagent. The standards are made in the range of 0.01 to 0.1 milligrams of formaldehyde and diluted to a total volume of 10 ml. with water. After 2 hours, the samples are compared with the standards. Total milligrams per liter of effluent sampled x 815 equals Total Aldehydes, expressed as P.P.M. (Parts Per Million) of formaldehyde.

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Quantitative Determination: Iodine-Bisulfite Method[4]. To 25 ml. aliquot of the water extraction, add 5 ml. of a 3% sodium bisulfite solution. Let stand for at least 2 hours. The solution is then titrated with 0.1 N iodine solution to a dark blue, using 1 ml. of a 1% starch solution. Excess of iodine is removed by adding dropwise, 0.05 N sodium thiosulfate solution. The solution is then brought to a faint blue with 0.01 N. iodine solution. Then 25 ml. of buffer solution (80 grams of sodium carbonate in 500 ml. of water, 20 ml. of glacial acetic acid and diluted to 1 liter). The solution is placed in the dark for 30 minutes. The aldehyde-bisulfite is then titrated with 0.01 N iodine solution. A blank is run on the reagents in a similar manner. One ml. of 0.01 N iodine solution is equivalent to 0.15 milligrams of aldehydes expressed as formaldehyde. Total milligrams per iter of effluent sampled x 815 equals Total Aldehydes, expressed as P.P.M. of formaldehyde.

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Total Phenols and Cresols. Qualitative Test: Millon's Reagent[5]. To prepare Millon's Reagent, 2 ml. or 27.2 grams of mercury is placed in 100 ml. Erlenmeyer flask. Add 20 ml. of conc. nitric acid (place under hood) and the mercury is allowed to dissolve at room temperature, ca. 15 minutes. The solution is diluted with 35 ml. of water, if basic salt separates out, add nitric acid dropwise until all is dissolved. Sodium hydroxide (10%) is next added dropwise with thorough mix-

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[3]**Laboratory Methods, Bureau of Industrial Hygiene, Connecticut State Department of Health, Hartford, Conn. (1950).**

[4]**Goldman and Yagoda; Ind. & Eng. Chem. (Anal. Ed.) 15,377 (1943).**

[5]**Chapin, R. M.; Ind. & Eng. Chem., 12, 771 (1920).**

TEST No. I

Type of Enamel: Oleo-Resin. Thickness of Catalytic Element, 1½ inches.

SAMPLING POINT	TEMPERATURE C	TEMPERATURE F	COMBUSTIBLE GASES Per Cent of L.E.L.	TOTAL PARTICULATE MATTER Milligrams per Cubic Meter	TOTAL PHENOLS P.P.M.	TOTAL ALDEHYDES P.P.M. (a)	TOTAL ALDEHYDES P.P.M. (b)
A	243	470	5-6	170	Neg.	103 118	
B	288	550	3-4	134	Neg.	136	
C	304	580	3-4	70.6 66.0	Neg.	146 131 136	

(a) Fuchsin Method for Aldehydes

(b) Iodine Method for Aldehydes

TEST No. II

Type of Enamel: Nylon. Thickness of Catalytic Element, 1½ inches.

SAMPLING POINT	TEMPERATURE C	TEMPERATURE F	COMBUSTIBLE GASES Per Cent of L.E.L.	TOTAL PARTICULATE MATTER Milligrams per Cubic Meter	TOTAL PHENOLS P.P.M.	TOTAL ALDEHYDES P.P.M. (a)	TOTAL ALDEHYDES P.P.M. (b)
A	196	385	1.0	3.9 2.8	100 105	Neg.	
B	232	450	1.0	3.2 1.1	130 131	Neg.	
C	246	475	1.0	2.8 4.2	143 151	Neg.	

ing until the curdy precipitate first formed no longer redissolves but disperses to a permanent turbidity. Then add 5 ml. of dilute nitric acid (containing 0.2 of its volume of conc. nitric acid) and the solution well mixed. The solution remains fit for use throughout an entire working day but probably should not be used the second day.

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To 10 ml. of the water extraction add 0.2 ml. of Millon's Reagent and 0.1 ml. of conc, nitric acid, then mix. Heat in a water bath that is maintained just below the boiling temperature, for 30 minutes. A yellow to deep red color indicates the presence of phenols and cresols, the approximate concentration is between 0.2 and 3.0 milligrams of phenol.

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Quantitative Determination: Bromine Method[6]. A 25 ml. aliquot of the water extraction is transferred to a 500 ml. iodine or glass stoppered flask and made to a volume of 200 ml. with water. Then 25 ml. of a KBr solution (250 grams of potassium bromide dissolved in one liter of water) and 10 ml. of hydrochloric acid (1:1) is added and the flask placed in a water bath at 25 C until the solution is also at 25 C. Exactly 25 ml. of $KBrO_3$ solution (3 grams of potassium bromate dissolved in one liter of water) is added, mixed, then placed in the same water bath for one hour, shaking occasionally. After the hour, 25 ml. of KI solution (200 grams of potassium iodides in one liter of water) is added, mixed, then placed in water bath for 30 minutes, shaking occasionally. The liberated iodine is titrated with 0.1 N sodium thiosulfate solution, adding 1 ml. of a 1% starch solution near end of titration. Once the solution is colorless, any return of the blue starch-iodine color is disregarded. A blank is run of the reagents in the same manner. The difference between the blank and sample titrations multiplied by 1.57 is the weight in milligrams of phenols and cresols in terms of phenol. Total milligrams per liter of effluent sampled x 260 equals Total Phenols, expressed as P.P.M. of phenol.

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Combustible Gases. The effluent was passed through the water-jacketed cooler, then led to a large flask. The flask was attached to a suction pump and the gases and vapors circulated through the flask. A glass tube was inserted through a stopper in the flask and a Davis Combustible Gas Indicator instrument attached to the open end of the glass tube. The gases were aspirated through the instrument, the vacuum pump functioning during the sampling period. The reading on the combustible gas instrument was recorded as Combustible Gases, Per Cent of L.E.L. (Lower Explosive Limit).

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Total Particulate Matter. Small filter papers, 1 inch in diameter, were placed in a desiccator overnight and then weighed. The papers were then placed in a holder, connected to the sampling end of the water-jacketed cooler and the effluent sampled. The sampling rate was 14 liters per minute for a sampling period of 20 minutes. The sample of particulate matter on the filter paper was returned to the laboratory and placed in a desiccator overnight. The filter paper was weighed and the increase in weight was expressed as Total Particulate Matter, Milligrams per Cubic Meter of effluent sampled. (See Figure 3).

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Temperature. The temperature of the effluent was determined by means of a thermocouple. The temperature readings were made at the same sampling points as the chemical tests.

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The above tests indicated that the catalyst was not functioning. As soon as it was convenient, the catalyst was examined and there was evidence that it had become inactive due to some metallic impurity. An examination of the catalytic installation showed that the rods for adjusting the Effluent Distributing Louvers had been constructed from galvanized iron pipe. Since these pipes had been directly above the Gas Burner, the zinc had vaporized and been deposited on the catalyst, making it inactive as indicated by the tests. This incident shows the importance of making chemical tests on the effluent after each installation of the catalytic combustion units on the wire enameling ovens and the value of instrumentation for indicating the continued operation of the catalytic action.

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(*Please turn to page* 1089)

TEST No. III

Type of Enamel: Oleo-Resin. Thickness of Catalytic Element, 2½ inches.

SAMPLING POINT	TEMPERATURE C	TEMPERATURE F	COMBUSTIBLE GASES Per Cent of L.E.L.	TOTAL PARTICULATE MATTER Milligrams per Cubic Meter	TOTAL PHENOLS P.P.M.	TOTAL ALDEHYDES P.P.M. (a)	TOTAL ALDEHYDES P.P.M. (b)
B	338	640	6-7	93.5 133.0	Neg.	75 66	133 130
C	466	870	0	6.3 5.6	Neg.	12 10	18 17

[6]Scott, R. D.; Ind. & Eng. Chem. (Anal. Ed.) 3, 67 (1931).

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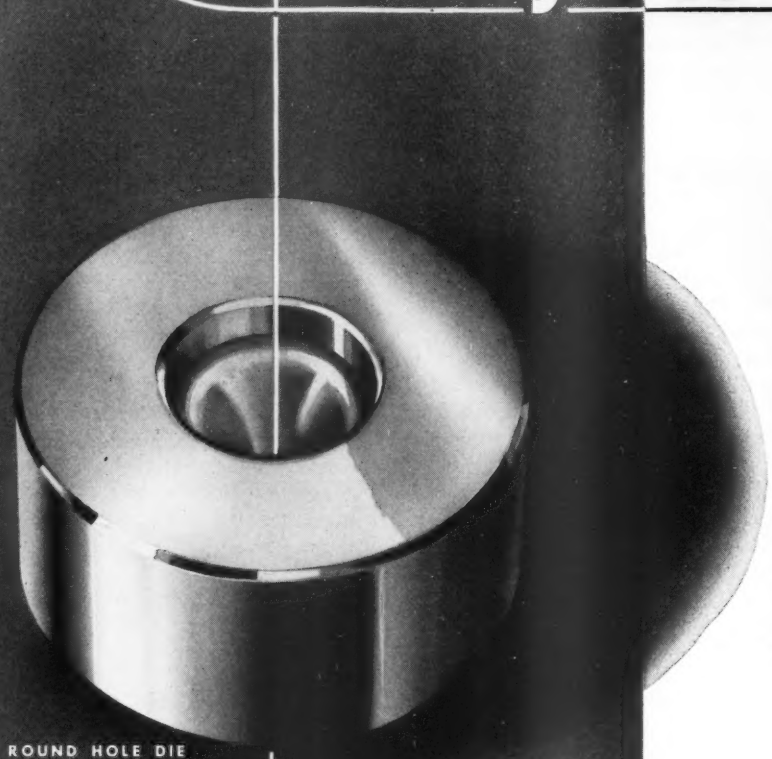

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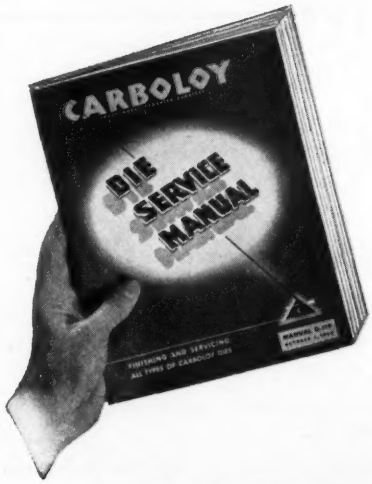

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Government Wire Production Information

Report Describes Tungsten Deposits in Alaska

Secretary of the Interior Oscar L. Chapman, has announced the release of a report and maps by F. M. Byers, Jr., Geologist, Geological Survey, on tungsten deposits in the Gilmore Dome, Steele Creek-First Chance Creek, and Pedro Dome areas which lie 10 to 20 miles northeast of Fairbanks, Alaska. This area, principally important because of its gold-bearing quartz lodes, has produced tungsten (scheelite) at intervals since 1916.

The tungsten occurs as the mineral scheelite (calcium tungstate) in thin beds and lenses of metamorphosed limestone, and calcareous mica schist, in quartz pegmatites, and in gold-quartz veins.

The scheelite deposits are segregated geographically in three areas: The Gilmore Dome area and Steele Creek-First Chance area in the southern part of the district and the Pedro Dome area in the northern part. The Stepovich mine in the Gilmore Dome area contains the largest known scheelite deposit in the district. During the periods 1915-18 and 1942 about 4,000 units of WO^3 (tungsten trioxide) as scheelite concentrates have been produced from three inclined shafts on the Stepovich lode.

The report is on file in the offices of the Geological Survey, Room 1033 (Library) GSA Building, Washington, D. C.; Room 100 Old Mint Building, San Francisco, Calif.; Juneau and Fairbanks, Alaska; and at the office of the Bureau of Mines, Federal Building, Anchorage, Alaska. A limited number of mimeographed copies are available free on application to the Director, Geological Survey, Washington 25, D. C.

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Mechanical Spring Producers Ask for More Metal

Manufacturers of precision mechanical springs asked the National Production Authority in September to ease their materials procurement problem by making it possible for them to order larger amounts of metal at one time.

The industry pointed out that the priority received by a precision machanical spring manufacturer from his prime contractor may require less than 10 pounds of steel.

The Precision Mechanical Springs Industry Advisory Committee recommended that industry members be permitted to accumulate CMF-4A allotments which do not exceed 100 pounds each of carbon and alloy steel or 50 pounds each of brass and wire mill products so that minimum mill quantities be accumulated. Also that these allotments be basketed under a single CMP allotment symbol and be validated for use in future quarters since the accumulation process would make it necessary to carry many of the orders from one quarter to another.

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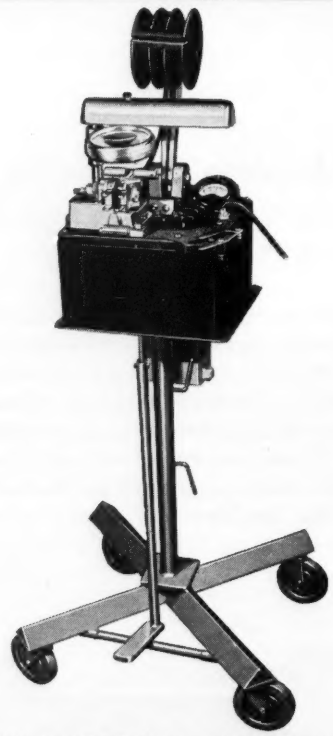
The adaptability of this unit for welding all types of wire, either ferrous or non-ferrous, in sizes from .005" to .020" diameter, makes it ideal for the fine wire manufacturer.



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The committee further recommended that a one-time special allotment of controlled materials be made to the industry to permit replenishing of inventories which were depleted during the early stages of the Controlled Materials Plan.

Although a few manufacturers have advised NPA that they prefer to be treated as manufacturers of CMP Class "B" Products, because of difficulty in placing orders for small quantities of controlled materials, the Committee reiterated its conviction that manufacturers of precision mechanical springs should continue to be classed as producers of "A" products.

Precision mechanical springs are used in practically every phase of manufacturing from guns, ships, tanks, and planes to automobiles, radios and washing machines.

Committee members reported that production currently is down 15 to 35% as compared with last Spring One member said that if materials were available, deliveries of precision mechanical springs could be made in from two to three weeks, as compared to six to ten weeks in the early part of the year.

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Screw Machine Products, Metal Stampings, Mechanical Precision Springs Industry Advisory Subcommittee Meeting

A subcommittee consisting of members selected from three industry advisory committees representing the screw machine products industry, the metal stampings industry, and the mechanical precision springs industry, met in September with officials of the Office of Price Stabilization to discuss the draft of a proposed tailored pricing regulations to cover the products of these three industries.

After a review of the proposed regulation it was decided that the operating and pricing practices of the tool and die industry generally would not lend itself to pricing under the proposed regulation and that this industry would probably require a separate tailored regulation. It was suggested that an industry advisory committee be appointed for the purpose of discussing the pricing problems of the tool and die industry.

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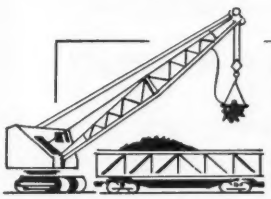

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In general, the proposed regulation would establish ceiling prices on the basis of pricing formulas which each manufacturer had in effect on January 25, 1950, using material and labor costs as of that date.

Generally speaking, it was felt that the proposed pricing method would establish ceilings somewhat lower than the general level of prices established by the industry under the General Ceiling Price Regulation (GCPR) and at about the same level that might be established under Ceiling Price Regulation 30 (Machinery), if CPR 30 should become mandatory for these three industries. These industries have contended that pricing under CPR 30 is impractical because of the job shop nature of their operations.

The proposed draft exempts small orders from ceiling price requirements. This would involve small orders of less than $200 in the case of mechanical precision springs. This exemption would be limited to a ratio of small orders to total sales established by a selected calendar month between November 1, 1950 and January 31, 1951. The committee felt this exemption should be established on the basis of a ratio to total sales to be selected by the seller for any calendar quarter from February 1, 1950 to January 31, 1951.

★ ★ ★

Welded Wire Fabric May Be Controlled Material

A proposed classification of welded wire fabric as a controlled material by the National Production Authority, has been endorsed by the Wire Reinforcing Mesh Industry Advisory Committee as an important step in minimizing the industry's distributive problems.

Beginning January 1, 1952, NPA said under the proposed plan welded wire fabric would be classed as a controlled material. After that date, manufacturers would be permitted to accept only authorized controlled materials (ACM) orders for wire mesh. Failure to convert existing defense-rated (DO) orders to ACM orders would deprive them of a place on manufacturers' production schedules.

The committee indicated that failure to include welded wire fabric

in Schedule 1 of CMP Regulation 1 (Rules of the Controlled Materials Plan) has placed an additional drain on manufacturers of this material. Because of this, some small consumers of controlled materials have supplemented their orders under the self-certification provisions of Direction 1 to CMP Regulation 1 with abnormally large requirements for non-controlled materials, including wire mesh.

This has tended to disrupt traditional customer-supplier relationships, industry members said.

NPA pointed out that classification of reinforcing mesh as a controlled material would permit more careful screening of orders for wire mesh placed by small users.

The committee recommended that users of small tonnages of controlled materials, combined with larger tonnages of wire mesh, should submit their over-all requirements to NPA for analysis to assure the receipt of allotments to cover first-quarter 1952 production.

NPA informed the committee that beginning with the first quarter of 1952, the industry would operate under production directives to be approved by the Steel Division. Under the proposed plan, wire mesh manufacturers would be classed as "further converters" pursuant to Section 8 of NPA's basic steel order, M-1.

It is anticipated that the new plan would create a more realistic supply-demand situation with regard to reinforcing mesh.

★ ★ ★

Vapor That Stops Rust Goes to War

Free 4 page illustrated folder brings you up to date on the vapor method of rust prevention that makes slushing with grease or oil unnecessary. Write: **Angier Corporation,** Framingham 3, Massachusetts.

★ ★ ★

Bolt, Nut & Solid Rivet and Screw Manufacturers IAC Meetings

The Bolt, Nut and Solid Rivet Industry Advisory Committee and the Screw Manufacturers Industry Advisory Committee met for the third time in September with officials of the Office of Price Stabilization to discuss a tailored pricing regulation.

A tentative proposed tailored pricing regulation for the two industries had been prepared by OPS

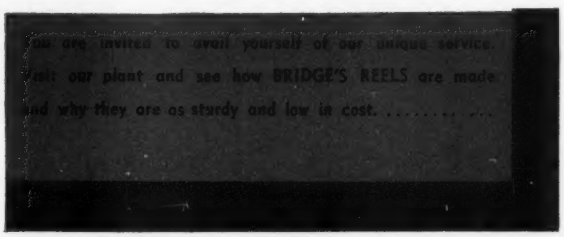
WOOD REELS
FOR
CABLE, ROPE AND WIRE

PLUS A SPEEDY SHIPPING SERVICE

If your mill is located within 200 miles of Hazardville, BRIDGE trucks will deliver reels to your door — overnight, if necessary.

For points beyond carload shipments out of Springfield, Mass., can be in St. Louis, for instance, in three days. L.C.L. shipments to points like Buffalo and Cleveland will arrive the second morning and be delivered to your door *at no extra cost.*

BRIDGE REELS are made in RETURNABLE and NON-RETURNABLE types in sizes from 12" to 96" in diameter. Furnished knocked down or assembled for SHIPPING or SHOP use. Also, REEL HEADS for STEEL DRUMS.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Visit our plant and see how BRIDGE'S REELS are made
and why they are so sturdy and low in cost. . . . . .

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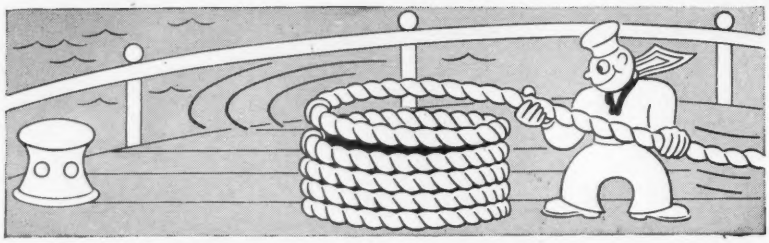
Phone Thompsonville, 4928



For a spring with accurate coiling see the man with a

Versatile Torrington Spring Coiler

In spring coiling, the words "Torrington" and "Versatile" are synonymous! When you desire springs produced to meet exacting requirements, just call the professional springmaker who has a Torrington coiler. He's the man who can fill your needs with accuracy, speed and economy. On special springs, our sales department will gladly assist you in finding a source of supply, or help your springmaker devise just the right tooling to produce it.

MODEL W-11 SPRING COILER
The 14 different Torrington Spring Coilers cover a range of wire diameters from .003" to .750".

SPECIFICATIONS
of the Model W-11 Spring Coiler

Wire diameter range: .015" to .072"

Wire Length per Spring: 0" to 42" (Extra Wire Feed Gears Available)

Coil Range (O.D.): 3/32" to 1-9/16"

Production: 23 to 190 springs per minute with variable speed drive.

Torsion and other attachments are available.

The TORRINGTON MANUFACTURING COMPANY
TORRINGTON, CONNECTICUT

and each committee went over the draft of the proposed regulation. Committee members made suggestions and recommendations for changes and clarification to make the regulation more workable. Generally speaking, both committees felt the proposed regulation offered a satisfactory basis for pricing.

In general, the regulation would establish ceiling prices on the basis of published list prices in effect on January 25, 1951, or in the absence of published list prices the seller would use the same formula for pricing which he had in effect on January 25, 1951. Provision would be made to take care of customary pricing situations.

★ ★ ★

Zirconium, Valuable Steel Alloying Metal

Minerals that yield zircons, used as semiprecious gems since Biblical times, contain zirconium, a valuable alloying metal used in steel making. In 1950, more than 1.8 million pounds of zirconium were used in the manufacture of steel.

Zirconium is usually added to the ladle of molten steel as a furnace is tapped. It removes harmful oxygen from the steel and, by reacting chemically with sulphur and carbon, has a cleansing effect. It is used in steel for some tough high strength parts, such as certain axles, crankshafts and rock drills. Some tungsten-free high speed tool steels contain zirconium, as do certain stainless steels containing a combination of elements to make them machine more easily. The element has an effect on the ability of some steels to harden under heat treatment.

Principal sources of zirconium are in the sands and gravels of Australia, India and Brazil. The beach sands of Florida, Oregon and the placer sands of Idaho also contain commercial quantities of the metal. Once considered a rare element, zirconium is now known to be more abundant in the earth's crust than such more familiar metals as copper, nickel, lead or zinc.

Some Uses In Pure Form

Zirconium is difficult to obtain from its minerals in pure metallic form. The metal was first detected in 1789 by Klaproth of Germany, but it was not isolated until 1925 by

two Dutch scientists, Van Arkel and DeBoer. Their method of obtaining zirconium metal puts the cost at a prohibitive $125 a pound. However, two other processes give promise of making zirconium a commercially feasible metal. It is now being used as a structural material for nuclear reactors, and because of its corrosion and heat resistance is believed to have many other industrial and military uses.

In Steel As Ferroalloy

For use in steelmaking, zirconium is generally added to the molten metal in the form of a ferroalloy, an alloy of any element with iron. In nonmetallic forms it has numerous uses outside of the steel industry.

In quantity the use of zirconium in the manufacture of steel is among the smaller alloy metals, ranking about with vanadium, and being much less than the use of nickel or chromium.

★ ★ ★

Wire Drawing in Europe

While most practices in Europe concerning wire drawing and the lubricants used in connection herewith are very similar to our own, one exception may be that of drawing steel wire in an acid bath in order to obtain a high lustre.

The lubricants used for this purpose are rye flower, yeast or other base material treated with fatty oil or soap and sulphuric acid in such manner that a stable dispersion is obtained. This process is used to a certain extent in a number of Western European countries and was described in a book published in 1934 by Dunod, Paris, that was written by **Maurice Bonzel.** That practice is still current.

★ ★ ★

Sintered Tungsten Carbide Products

The Office of Price Stabilization has issued a new manufacturers' ceiling price regulation covering sales of sintered tungsten carbide products and mixed powders, effective September 10, 1951, under CPR 71 and Amend. 13 to CPR 30.

The regulation applies to all sales by manufacturers of these products, except export sales and sales for export which are covered by the export regulation, CPR 61.

★ ★ ★

NARCO METAL BOUND REELS provide 300% more service. Exhaustive tests have shown a 24" all-wood reel will average four trips—*with repairs.* A NARCO METAL BOUND REEL of the same size will average 12 to 16 trips *with no repairs.* All for only approximately 50% more cost.

NARCO METAL BOUND REELS are made in 12" to 48" idameters. All-wood reels from 12" in diameter to any size required.

All reels shipped assembled or knocked down for assembly to wood or steel drums.

Further information or quotations promptly furnished.

North Anson Reel Co.

TELEPHONE MADISON 187-2 NORTH ANSON, MAINE

Efficient Pickling with . . .

Rodine®

PICKLING ACID INHIBITORS

Use RODINE in sulfuric and muriatic acid baths for improved pickling and increased production.

In straight line pickling of wire, rod and tubing, RODINE makes available more metal for drawing by protecting steel from acid attack. In batch pickling of sheet steel, RODINE improves the surface. In rapid, continuous strip pickling, RODINE not only saves acid and metal, but also prevents over-pickling during line shutdowns.

Now, more than ever, it is cheaper to pickle with RODINE than without it.

"RODINE" meets Government Specification No. U.S.N. 51-I-2.

Write for descriptive folder on RODINE Pickling Acid Inhibitors.

AMERICAN CHEMICAL PAINT COMPANY

AMBLER, PENNA.

Resellers Machinery & Related Manufactured Goods

The Office of Price Stabilization amended its ceiling price regulation for resellers of machinery and related manufactured goods (CPR 67) to permit resellers to use their ceiling prices established under the General Ceiling Price Regulation or Supplementary Regulation 29 while awaiting price approval from OPS. The action is covered by Amdt. 2 to Ceiling Price Regulation 67, effective September 22, 1951.

CPR 67 provides that a reseller who cannot price under Sections 3 and 4 may apply to OPS for a price under Section 5, but must wait 30 days before putting such price into effect, unless he receives approval from OPS in the meantime.

The amendment permits the reseller to apply for a ceiling price and continue using a ceiling price he has established under GCPR or SR 29, or if he has not established a GCPR price he may use the ceiling price he has applied for, but in such case he may not accept payment for more than 75 percent of such price while awaiting approval from OPS.

The amendment is intended to remove any hardship to resellers who find it necessary to apply to OPS for a ceiling price.

★ ★ ★

Philips to Hold Diffraction School

North American Philips Company, Inc. held its eleventh X-Ray Diffraction School at the company's plant, 750 South Fulton Avenue, Mount Vernon, N. Y. during the week of Monday, Oct. 8 through Friday, Oct. 12.

During the week-long program on X-ray diffraction, considerable time was spent on question and answer periods and on laboratory sessions, thus giving the participants ample opportunity to become thoroughly familiar with problems involving actual use of various types of equipment.

For the past five years, Philips has held the X-ray Diffraction School semi-annually, usually in April and October. The response from industry in enrolling scientific personnel for training in the use of such equipment has grown steadily since the course was first initiated.

★ ★ ★

Outstanding Personalities of the Wire Industry

Charles E. Harrison, Steel Company of Canada, Retires

More than 53 years of service with the **Stelco** and companies which preceded it, closed officially for **C. E. "Charlie" Harrison** on October 1. Mr. Harrison retired on pension from his position as General Sales Manager of the Wire, Wire Products and Screw Divisions.

He is succeeded in this position by **Charles P. Short,** who has been Assistant General Sales Manager of these divisions for the past three years.

Mr. Harrison started to work for the Ontario Tack Company on July 10, 1898, as a stenographer, after completing collegiate and business college courses. The Company had been formed in 1886, with F. H. Whitton as Secretary - treasurer, while J. Orr Callaghan was Works Manager. C. S. Wilcox, who became the first President of The Steel Company of Canada, Limited, in 1910, also was associated with the Tack firm. In 1907 it was merged with the Canada Screw Company, of which Cyrus A. Birge was president, and the plant and office were moved from Queen Street to the West side of Wellington Street.

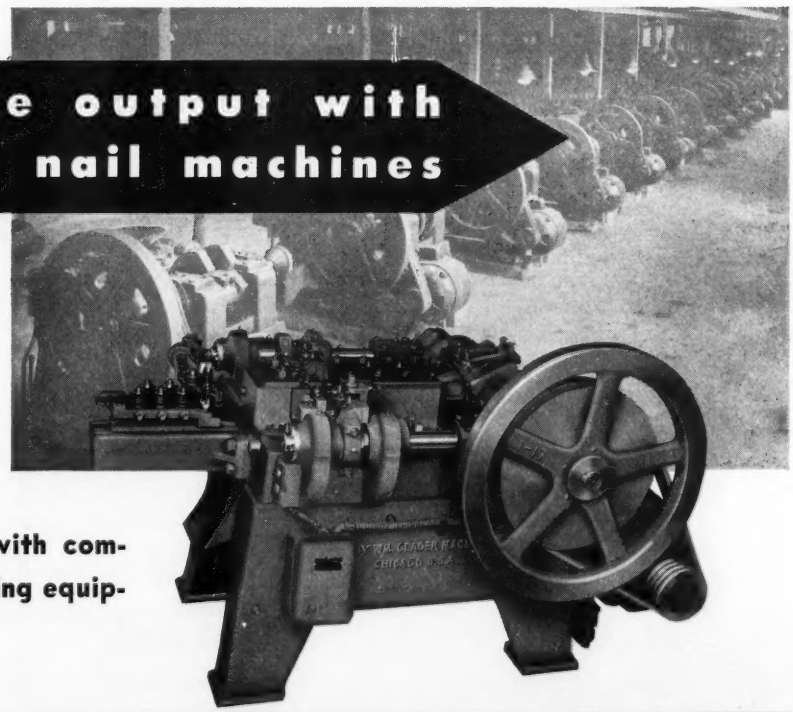
For Mr. Harrison, changes meant only steady progress. He became invoice clerk, then order clerk, and rose through many phases of Wire and Screw Products sales. In September, 1910, two months after Stelco came into being, he took charge of Wire Products sales. About ten years later he was appointed Assistant Sales Manager of the Company in charge of Wire and Screw Products. His appointment as General Sales Manager, embracing all the enlarged Wire and Screw Products Divisions of Hamilton and Montreal, came in 1939.

Mr. Harrison is widely known across Canada, having travelled the country on numerous occasions calling upon the trade.

Aside from his business interests, Mr. Harrison has been active in community life as a member of the Hamilton Club, the Hamilton Golf and Country Club, the Hamilton Chamber of Commerce, and the Canadian Manufacturers' Association. He is a past President of St. George's Benevolent Society, Past Chairman, Hamilton Playgrounds Commission, and a member of the official board of Centenary United Church, a member of The Wire Association as well as being a fisherman, gardener and family man. His home is at 215 Herkimer Street.

His native County Armagh, Ireland, was too small a world for Charlie Short. As soon as he graduated from school, he went to Texas and worked in the oil industry. Then he became a Sales Representative in Buffalo and Chicago for a large

high tonnage output with GLADER wire nail machines



A size and type machine available to make everything from tacks and brads to 12" spikes with maximum efficiency.

Write for 12 page bulletin with complete information on nail making equipment.

WM. GLADER MACHINE WORKS
210 N. RACINE AVENUE
CHICAGO 7, ILLINOIS
Export Dept.: 122 E. 42nd Street, New York 17, N. Y.

American Steel and Wire Company. In 1936 he joined Stelco's Wire Division.

As a Sales Representative, he introduced High Carbon Wire lines to Canadian manufacturers, and handled the first sales of Rope Wire after Stelco began making this product. When the Manufacturers' Wire Division was set up in 1942, Mr. Short became Sales Manager. He was appointed Assistant General Sales Manager, Wire, Wire Products and Screw Products Divisions, in 1948.

★ ★ ★

W. B. Pierce Officer of Allegheny-Ludlum

William B. Pierce has been elected a vice president of Allegheny Ludlum Steel Corporation.

Mr. Pierce, who joined the company in 1945 as manager of the sales development and engineering service department, was named technical director in December, 1950, when he was given full responsibility for research and metallurgical activities. He will retain that position as a vice president.

Mr. Pierce has been active in metallurgical research since 1929 when he was graduated from the University of Illinois and took a position with Aluminum Company of America. In 1937 he assumed the position of sales manager of Rustless Iron & Steel Corporation and later became manager of development there.

Headquarters of the newly elected vice president will be established in the company's new research laboratory soon to be opened at Brackenridge, Pa.

★ ★ ★

Dennis Ord Joins Sam Tour & Co., Inc.

Mr. Dennis Ord has joined **Sam Tour & Co., Inc.** of 44 Trinity Place, New York 6, N. Y.

During World War II, Mr. Ord did work at the Naval Research Establishment at Halifax, Nova Scotia in connection with counter measures to the German Acoustic Torpedo. He served in the Canadian Navy for two years and saw service overseas.

In 1942, Mr. Ord obtained his B. A. degree from McMaster University in 1945 his M. Sc. in Chemistry from Acadia University. Mr. Ord will be located in the Research and Development Laboratories of Sam Tour & Co., 44 Trinity Place, New York City, where he will specialize in the chemical analysis of Titanium and Titanium Alloys.

★ ★ ★

Cyclone Fence Vice President Retires

After more than 40 years of service with the **American Steel & Wire Company,** 38 of which were spent with the company's **Cyclone Fence Division, Raymond G. Russell,** pacific Coast vice president of that division, has retired.

At the same time, **Carl A. Ten Hoopen, Sr.,** assistant general sales manager of the Cyclone Fence Division, was appointed to the post of Pacific Coast manager of sales.

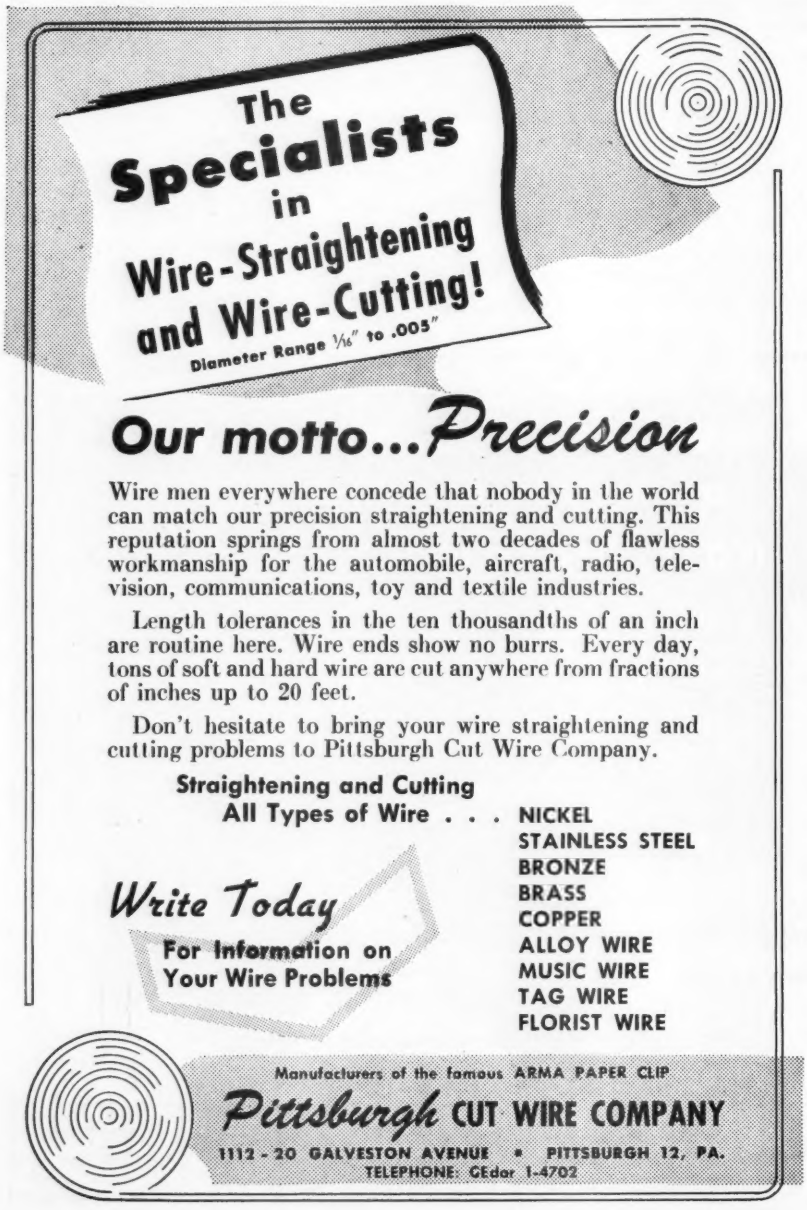
Mr. Russell was appointed Pacific Division vice president for the Cyclone Fence Division in 1944.

Mr. Ten Hoopen was appointed sales manager for the central district of the company at Cleveland in 1933 and was named Eastern District sales manager in 1946. In July of this year he was promoted to assistant general sales manager.

★ ★ ★

San Francisco Representative for Division

J. Peter Brehm has been named district sales representative in the San Francisco area for the **Woven**


The
Specialists
in
Wire-Straightening
and Wire-Cutting!
Diameter Range 1/16" to .005"
Our motto...Precision
Wire men everywhere concede that nobody in the world can match our precision straightening and cutting. This reputation springs from almost two decades of flawless workmanship for the automobile, aircraft, radio, television, communications, toy and textile industries.
Length tolerances in the ten thousandths of an inch are routine here. Wire ends show no burrs. Every day, tons of soft and hard wire are cut anywhere from fractions of inches up to 20 feet.
Don't hesitate to bring your wire straightening and cutting problems to Pittsburgh Cut Wire Company.
Straightening and Cutting
All Types of Wire . . .
NICKEL
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Wire Fabrics division of **John A. Roebling's Sons Company.**

Mr. Brehm, a graduate of Santa Monica, California, is a veteran of World War II. Prior to his new appointment, he was a member of the division's Los Angeles sales force.

★ ★ ★

A. S. & W. Moves Up Two Metallurgists

Alex L. Greshan has been appointed division metallurgist for standard practices in the Metallurgical Department of the **American Steel & Wire Company,** it has been announced by **James R. Thompson,** manager of the Metallurgical Department.

Mr. Gresham, 42, a native Ohioan, began work for the Wire Company, a U. S. Steel subsidiary, at its Newburgh Works in 1935. He was graduated the same year by Case Institute of Technology with a degree in metallurgy.

He has held various metallurgical positions at Newburgh Works and Cuyahoga Works before being appointed to his present post in the Rockefeller Building, Cleveland, Ohio.

At the same time, Herbert H. Smith, works metallurgist at the Joliet (Ill.) Works, announced the appointment of Joseph W. Gray as division metallurgist. Mr. Gray started with the Wire Company in 1934, following his graduation from Purdue University as a chemical engineer.

★ ★ ★

New England Steel Mill Interest Revived

Interest is being gradually revived in the proposal to erect a $250,000,000 steel mill in the New London area of Connecticut. Public comments by U. S. Senators **William E. Benton** and **Brien McMahon** of Connecticut, and by President **Walter H. Wheeler, Jr.,** president of the New England Council, have been interpreted in state industrial circles as the prelude to a more determined effort to translate long-discussed plans into action. Either private enterprise or government assistance may be more forcibly advocated shortly, although sponsors have declared there is no taint of Socialism in their plans.

★ ★ ★

Calvin Sterling

Calvin Sterling of 60 Abbotsford Road, North Plainfield, New Jersey, died on October 1st at the age of forty-nine.

Mr. Sterling had been associated with **The International Nickel Company, Inc.** since his graduation from Pennsylvania State College in 1925. From 1925 to 1930 he was a chemist at the Huntington, West Virginia Works of the company. He was transferred to its Bayonne Works in 1930. Since 1935 he had been head of the Analytical Section of the Research Laboratory at Bayonne, New Jersey.

★ ★ ★

New Company Making Rods

Announcement has been made of the formation of a new company that will engage in the production of steel wire rods of from ¼" to ¾" in diameter.

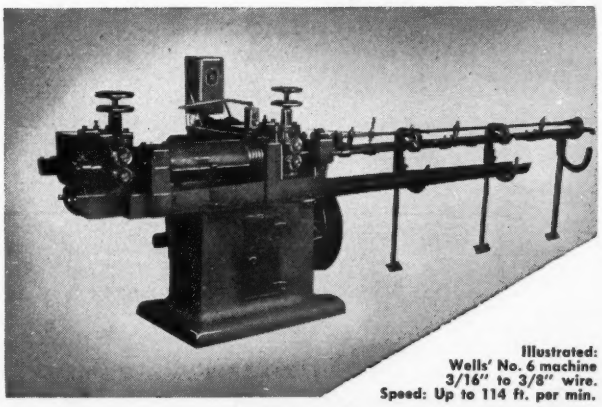
The concern is the **Steel Wire and Rod Corporation,** River Avenue, McKees Rocks, Pa., headed by **W. C. Riesberg,** President. The plant was scheduled to start operating in late September.

Mr. Riesberg also announced the completion of a new warehouse and office building for the Carson Steel Company, which he also heads.

★ ★ ★

TOUGH JOBS WON'T STOP A WELLS STRAIGHTENER AND CUTTER

Here's what one user has been doing:



Illustrated: Wells' No. 6 machine 3/16" to 3/8" wire. Speed: Up to 114 ft. per min.

Cutting 3/8" hot rolled rods for 9 long years 24 hours a day.

His Wells machines are still going strong. Because of the scale, this concern says it is an exceedingly tough job - but the Wells machines take it.

The machines are cutting at 120F.P.M., with tolerances of ⅛" in this plant. Nine years of steady operation is a long test. What these machines can do for one they will do for you. Made in sizes to handle 1/16" to ⅝" stock.

Every WELLS machine is backed by 57 years of experience and all our efforts are directed toward making good machines better. WELLS machines are rugged, dependable, accurate *and low in cost.*

Get the facts today. Send for Catalog No. 50 describing this and other Wells wire working machinery. Address inquiries

Frank L. Wells Company

5821 FIFTH AVENUE

KENOSHA **WISCONSIN**

Builders of Fine Wire Making Machinery

Cowles Adds New Sales Territory

Cowles Chemical Company announces the appointment of **Don E. Weaver** as a Technical man in their Metal Cleaner Department for the Indiana-Southern Ohio territory. This appointment is part of Cowles' expansion program to cover more completely the metal cleaning market.

Mr. Weaver is qualified to give assistance to the metal working industry. He attended Ohio State University and the University of Cincinnati before entering production work and enamel and pickle control work for a manufacturer in Ohio. Just previous to coming with Cowles, Don was employed by a large manufacturer in the state of New York in a supervisory capacity for metal cleaning preparatory to porcelain enameling.

★ ★ ★

Mathews Joins Ross Engineering

Tom Mathews, who for a number of years has been engaged in industrial processing and high temperature work as well as rubber research throughout the Midwest, has joined the staff of **J. O. Ross Engineering Corporation** as a sales engineer in the Detroit office.

★ ★ ★

Standard Machinery Adds to Field Staff

B. H. Davis, Secretary and Sales Manager for **The Standard Machinery Company,** Mystic, Conn., has announced the appointment of two sales engineers for their line of extruding machines and accessories for the rubber, plastics and electrical wire and cable industries. They are **Ralph B. Symons** and **William A. Shilling.**

Mr. Symons is a chemical engineering graduate of the University of Toronto and for eleven years was associated with Dunlop Tire & Rubber Goods Co., Ltd., and Canada Wire & Cable Co., Ltd., in Canada.

Here in the United States, he has been with Firestone Tire & Rubber Co., Wilmington Chemical Corp. and, for sometime has been a consulting engineer for the rubber and plastics industry. He will cover New England territory for Standard, except for Western Connecticut.

Mr. Shilling, an Ohio Wesleyan graduate, has been associated with the Carboloy Company, in Detroit and was with the Armed services for two years in World War II. Since that time, he has specialized in equipment for the rubber and plastics industry. He will cover Western Connecticut, New York and New Jersey for the Standard line.

★ ★ ★

Norton Forms Export

The formation of a new company to be known as **Norton Behr-Manning Overseas, Inc.,** has been announced by **Norton Company** of Worcester, Massachusetts, and **Behr-Manning Corporation** of Troy, New York. The new company will handle all of the export business and direct the subsidiary plant operations of these two corporations throughout the world. Headquarters will be in Worcester with branch offices located in New Rochelle, New York and New York City.

Norton Company is the leading American manufacturer of grinding wheels and abrasive products, and Behr-Manning Corporation, a subsidiary of Norton Company, is the leading American manufacturer of coated abrasive products.

★ ★ ★

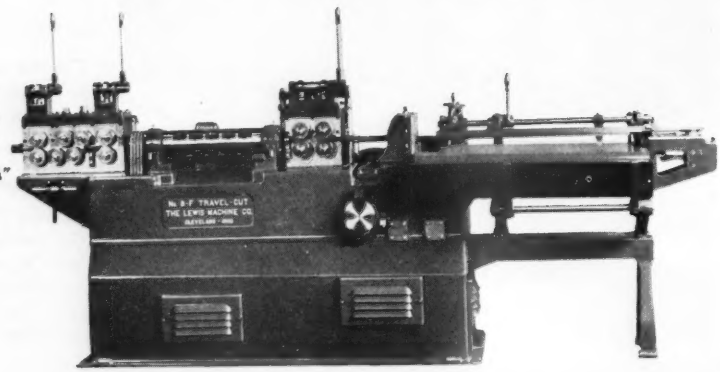
Fast, Accurate, Economical

STRAIGHTENING and CUTTING

with LEWIS **TRAVEL-CUT**

MACHINES

22 Models to handle from 1/16" to ¾" Round, Hex, Flat, Shapes.



Simple in design, rigid in construction, Lewis TRAVEL CUT will deliver continuous dependable service under the most severe, high production conditions—day in, day out. Feeds wire from the coil, straightens accurately, gauges to uniform length, and cuts clean without stopping the wire. For steel, brass, aluminum and alloy wire. Cut your cutting costs with the Lewis TRAVEL CUT. Full details on request.

Exclusive Representatives

EAST: Penn Machinery Co., 117 North Third Street, Philadelphia 6, Penn.

MIDDLE WEST: Steel & Wire Machinery Co., 15457 Euclid Ave., Cleveland 12, O.

CENTRAL: Moslo Machinery Co., 2448 Prospect Avenue, Cleveland 15, Ohio.

WEST COAST: Hoffman & Heartt, 3005 So. Grand Ave., Los Angeles 7, California

CANADIAN: Empire Engineering Co., 11 Wellington St. E., Toronto 1, Ontario.

CONTINENTAL EUROPE: Gaston E. Marbaix Ltd., Devonshire House Vicarage Crescent, London S. W. 11, England.

The LEWIS MACHINE Company

3441 E. 76th Street, Cleveland 27, Ohio

Also agents in Paris, Stockholm, Rotterdam, Brussels, Zurich, Milan, Bombay and Melbourne

Wire Products Concern Moves Office

Industrial Wire Products Corporation of Los Angeles and San Francisco has moved its headoffice to its new building, located at 5649 Alhambra Avenue, Los Angeles (CApital 2-7131). The new site comprises over three acres, and the executive offices are located in the corporation's new two-story warehouse building, which has some 40,000 square feet of space. All material handling, receiving and shipping will be expedited by a complete system of overhead craneways.

The company is fast becoming one of the major jobbing units in the Wire and Wire Cloth industry on the Pacific Coast. The Corporation has recently announced the election of Earl R. Potter as President and General Manager.

Mr. Potter was for some 20 years superintendent of the Wire Mill for the California Wire Cloth Corporation in South San Francisco, having complete charge of all operations, which included the lay-out of their new $750,000 wire mill. Prior to that, Mr. Potter was connected with E. H. Edwards Wire Rope Company, Specialty Wire, and Standard Wire of California.

With his knowledge of the manufacture of all types of wire, Mr. Potter's expansion into the "Wire Products" field was inevitable. In addition to handling all types of wire, wire cloth, netting, bale ties, welded fabric, etc., **Industrial Wire Products Corporation** specializes in straightening and cutting wire of all grades and types. Straightening and cutting facilities are being increased substantially to handle all sizes up to ½" diameter wire or rods. The Corporation is also currently spooling and braiding wire for many applications.

★ ★ ★

Rossiter Becomes New England Manager for Nopco

Effective October 1, **Laurence E. Rossiter** took over as New England District Sales Manager for **Nopco Chemical Company.** Announcement of Mr. Rossiter's promotion to replace Harold J. Waldron who retired on that date was made by G. Daniel Davis, Vice-President in Charge of Industrial Sales from the Nopco home offices at Harrison, New Jersey.

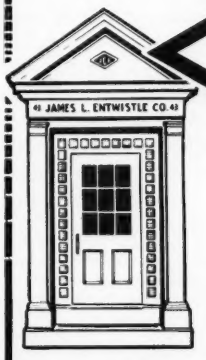
Mr. Rossiter has been with Nopco for over 10 years, having joined the company in 1940 as a member of the Products Control Laboratory staff. Later he was promoted to Chief Chemist of the Textile Service Laboratory where he was responsible for handling customer service problems and new product development for the textile field. In 1946 he joined the field force and continued as technical sales representative in southern New England until his recent advancement.

★ ★ ★

Eaton Manufacturing Company Appointments

F. I. Goodrich, since 1943 factory manager at the Spring Division plant of the **Eaton Manufacturing Company** in Detroit has been named as general manager of the Spring Division, succeeding the late W. H. Wallace.

Mr. Goodrich in 1925 joined the Beans Spring Company, of Massillon, O., which was later acquired by Eaton. He was transferred to Detroit in 1926, and after working in various departments was appointed factory manager in 1943.



JLE

SERVING THE WIRE INDUSTRY THROUGHOUT THE WORLD

- Standard Sets of Spark-Testing Equipment
- Take-ups and Re-spoolers
- Reelers
- Coilers
- Spoolers
- Collapsible Coiling Reels
- Wire Sparkers and Accessories
- Hand Locators
- Electrode Units and Stands
- Measuring Machines, Counters and Accessories
- Wire Guide Units
- Pay-off Reels Stands
- Electronic Devices
- Conduit Connection Sets
- Wire Pre-Heater
- Disk Brakes and Controls, Drag Units and Slip Clutches
- Wire Marking Machines, Type Strips, Inks
- Labelling Machines
- Pneumatic Equipment and Controls
- Miscellaneous Equipment
- Hydraulic Equipment and Controls
- Hi-Pot Test Sets
- Cable Handling Equipment for Warehouse Use

See page 1032 for news on the JLE Automatic Insulation Fault Relocating Equipment

JAMES L. ENTWISTLE CO.

43 CHURCH STREET, PAWTUCKET, RHODE ISLAND, U. S. A.

European & South American Agents: M. CASTELLVI, INC. 150 BROADWAY, NEW YORK 7, NEW YORK

British Associate: GENERAL ENGINEERING CO., LTD. BURY ROAD, RADCLIFFE, LANCASTER, ENGLAND

JLE JLE JLE JLE JLE

H. H. Clark has been appointed assistant general manager in charge of coil springs. He joined Eaton's spring division in 1931, coming from the Cleveland Wire & Spring Company. He acted as sales engineer on coil springs until he was made manager of that department at Eaton in 1939.

★ ★ ★

Chase Brass Appoints Regional Manager

Appointment of **John M. Gehl, Jr.,** for the past 11 years manager of the **Chase Brass & Copper Company** warehouse in New Orleans, La., as regional manager for the concern was announced by Bruce A. Dean, vice president. Mr. Gehl will continue to serve as district manager at New Orleans, while as regional manager he will have under his supervision the territories now served by the Chase warehouses and sales offices in Dallas and Houston, Texas, and Atlanta, Ga. His appointment is effective immediately.

In this newly-created post, Mr. Gehl will act as liaison with the headquarters staff and the branches in his territory, as well as assist and supervise the branches under his immediate jurisdiction.

Mr. Gehl's entire business experience has been with Chase, becoming associated with that firm on October 10, 1927, when he accepted a position as office clerk in the New Orleans office. He held that position for two years when he was made a salesman and continued in that capacity until March, 1940, when he was promoted to his present position of branch manager.

★ ★ ★

Joins Lewis Welding and Engineering Co.

Johan A. Muller has joined the **Lewis Welding & Engineering Corporation, Bedford, O.,** as head of the newly formed development department.

Mr. Muller, who holds more than 30 U. S. Patents covering various phases of his work, has specialized in the design and development of hydraulic equipment, particularly in its application to the plastics and rubber manufacturing industry.

A native of the Netherlands, Mr. Muller is a licensed professional engineer in the state of Ohio. For a number of years he served as chief engineer of the research and development laboratory of the Hydraulic Press Manufacturing Company.

★ ★ ★

"National Service Week" Observed by Harnischfeger Dealers

"Proper care means longer wear." This theme will be emphasized again and again as National Service Week, September 15 to 21, is observed by over 700 dealers, branches and warehouses of **Harnischfeger Corporation,** Milwaukee.

Through this observance they hope to make the users of P&H equipment, both in the industrial and construction fields, more aware of the need and the value of proper and timely maintenance work to conserve equipment and secure better service from it. The 67-year-old firm makes excavators, cranes, hoists, arc-welding equipment and other construction and industrial items.

★ ★ ★

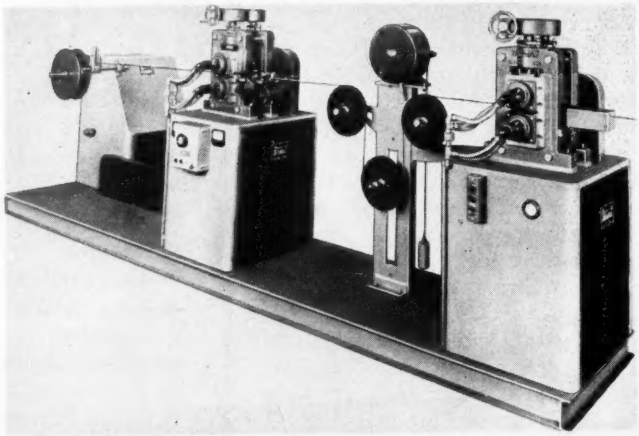
StANAt

TWO-STAND

WIRE

FLATTENING MILL

6" DIAMETER — WATER COOLED ROLLS



Illustrated Model T-400

High Speed — Low Cost — Rugged Construction

Simplicity of design makes this machine easily adaptable to short or production runs. ● Compact electrical system operates from A.C. source and provide stepless speed adjustment with automatic wire tension. ● Edging rolls are provided with quick release for easy threading.

Also available in single units or other combinations.

STANAT MANUFACTURING COMPANY

47-28 37th Street Long Island City, N. Y.

Designers and mfrs. of rolling mills, gang slitters, wire mill and special machinery

CONSULT OUR ENGINEERING DEPARTMENT REGARDING YOUR ROLLING AND SLITTING PROBLEMS

A Review of Recent Wire Patents

No. 2,566,400, WIRE GARMENT HANGER FORMING MACHINE, patented September 4, 1951 by Oliver R. Brekle, Birmingham, Ala., assignor to Precision Crown Company, Birmingham, Ala., a partnership composed of Milton M. Mangus and Oliver R. Brekle.

Pre-cut wire blanks are fed, one at a time, to a forming mechanism comprising a hopper for the blanks having a sloping bottom with a narrow slot therein at the side nearest the machine and adapted to pass the blanks, one at a time, a longitudinally extending agitating bar alongside the hopper adjacent the slot, a resilient support mounted under the hopper in position to receive the blanks, a forming anvil, and swinging arms having bosses thereon to engage the lowest blank on the support and bend it about the forming anvil.

★ ★ ★

No. 2,566,644, METHOD FOR MANUFACTURE OF METAL BASKETS, patented September 4, 1951 by Jan van der Togt, Zwijndrecht, Netherlands, assignor to Vennootschap onder de firma Tomado, Zwijndrecht, Netherlands, a partnership of the Netherlands.

The method is adapted to baskets of wire each having a two-piece central bottom composed of an upper and lower part to which the ends of the radial pieces of wire forming the bottom wires and extending upwardly as wall wires are welded.

★ ★ ★

No. 2,566,801, WIRE UNWINDING REEL, patented September 4, 1951 by A. O. Jackson, and Clifford L. Jackson, Ferndale, Mich., assignors to Walker Wire Company, Ferndale, Mich., a corporation of Michigan.

It is said that, although the wire is unwound from the stationary reel at high speeds, kinking and looping will not occur.

★ ★ ★

No. 2,566,846, APPARATUS FOR INSULATING CONDUCTORS, patented September 4, 1951 by Samuel M. Martin, Baltimore Md., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York.

A strand of insulating material is simultaneously extruded and wrapped spirally around the continuously advancing wire.

★ ★ ★

No. 2,566,848, WIRE WINDING AND TENSIONING DEVICE, patented September 4, 1951 by Jack A. Morton, Neshanic Station, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York.

Complete Description and Drawings of Patents May Be Had for 50 cents, outside the United States and Canada $1.00. Address, Wire & Wire Products, 300 Main St., Stamford, Conn.

The wire itself is employed as an electric conductor to signify, upon breakage, that fact to an electronic device for breaking the winding means of the device.

★ ★ ★

No. 2,567,162, COATED ELECTRICAL CONDUCTOR AND METHOD OF MAKING SAME, patented September 4, 1951 by Philip Francis Sanders, Lansdowne, Pa., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delaware.

There are 15 claims, some to the product and others to the process. Over the ceramic coating is a superposed sheath coating of a copolymer of tetrafluorethylene and another polymerizable organic compound containing an ethylene double bond.

★ ★ ★

No. 2,567,163, APPARATUS FOR POLISHING CONTINUOUS STRIP METAL, patented September 4, 1951 by David A. Wallace, Grosse Pointe Farms, Mich., assignor to Chrysler Corporation, Highland Park, Mich., a corporation of Delaware.

The material is simultaneously polished on both sides.

★ ★ ★

No. 2,567,271, APPARATUS FOR HANDLING ROD AND WIRE BUNDLES OR THE LIKE, patented September 11, 1951 by Bruce N. Bletso, Cleveland Heights, Ohio, assignor to The American Steel and Wire Company of New Jersey, a corporation of New Jersey.

This apparatus includes a pair of

Use **"ALBRO" METAL** *for Long Life and Economy in Pickling*

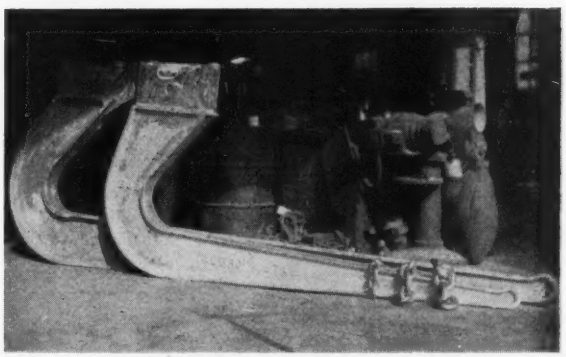
for: HAIRPIN HOOKS • PICKLING CHAINS • BASKETS, ETC.

They last! You can cut your hook costs in half. "ALBRO" METAL IS extremely resistant to acid corrosion—and very strong.

One customer used our hooks for 5 years and ordered 20 more—the corrosion over that period had been negligible.

We extend to you an opportunity to avail yourselves of our engineering co-operation. We build to your specifications.

Send us your drawings. Or wire, write or telephone, asking to have a representative call on you.



Other "ALBRO" METAL products are: CRATES AND HANGERS, BOLTS & NUTS.

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C-shaped ring gears in juxtaposition the gears of which may be rotated in order to bring the spaces between the ends in predetermined positions. Associated therewith is an elongated skid.

★ ★ ★

No. 2,567,300, WIRE ROPE, patented September 11, 1951 by Harvey W. Riddle, Branford, Conn., assignor to The American Steel and Wire Company of New Jersey, a corporation of New Jersey.

In this rope the outer wires of each strand and the outer wires of the core contact each other in such a manner that one wire in one of the contacting members will always rest in a saddle formed by two adjacent wires of the other contacting member.

★ ★ ★

No. 2,567,347, STRANDING MACHINE, patented September 11, 1951 by Robert C. Pierce, Niles, Mich., assignor to National-Standard Company, Niles, Mich., a corporation of Michigan.

The method includes a pair of rotor members mounted in spaced apart relation for rotation about a common axis, a pair of spool cradle devices, one journalled at one end in each of these rotor members, drive means for the rotors for driving the same in synchronism, and means for preventing rotation of the spool cradle devices with the rotor members.

★ ★ ★

No. 2,567,396, FISHHOOK - FORMING DEVICE, patented September 11, 1951 by Walter S. Peterson, Sr., Denver, Colo.

Gravity-induced sliding of wire sections along a special groove in a table is provided for whereupon the sections are acted upon to form the fishhook.

★ ★ ★

No. 2,567,520, TENSION REGULATION COIL SPRING, patented September 11, 1951 by William K. McInerney and James M. McInerney, Grand Rapids, Mich.

The spring assembly is for cushions and the like and includes two enclosed springs, one helically wound with the other and the lower end portion of one extending through the enclosure for connection with the support for the assembly.

★ ★ ★

No. 2 567,537, WIRE WINDING MACHINE AND METHOD OF FORMING COILS OF WIRE, patented September 11, 1951 by Ernest Robert Workman, Chicago, Ill.

There are 14 claims covering this machine which comprises a device for withdrawing wire from a supply coil, a rewind reel for winding the withdrawn wire in a rewound coils, and means for rotating the withdrawn wire a predetermined amount about its longitudinal axis in its travel from the supply coil to the rewound coil whereby the wire in the rewound coil has a predetermined torsion strain therein.

★ ★ ★

No. 2,567,635, WIRE-DRAWING MACHINE MOTOR, patented September 11, 1951 by Oswald M. Bundy, Cleveland, Ohio, assignor to The Clark Controller Company, Cleveland, Ohio, a corporation of Ohio.

The control is applicable to multiple die block wire drawing machines.

★ ★ ★

No. 2,567,770, APPARATUS FOR MAKING ELECTRICAL MEASUREMENTS, patented September 11, 1951 by Arthur J. Ehlschlager, Elmwood Park, Ill., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York.

Thirty claims are included in this patent. Counterbending of the wire is effected by a method and device wherein, by relating the direction of counterbending forces to the plane of the initial coil set, torsional rotation of the strand is minimized.

★ ★ ★

No. 2,567,788, ADJUSTABLE HANDLE FOR ATTACHMENT TO CANS, patented September 11, 1951 by Peter Livingstone Salmon, Glasgow, Scotland.

The handle is formed of a length of flexible wire, bent to shape.

★ ★ ★

No. 2,567,819, COIL HANDLING APPARATUS, patented September 11, 1951 by Elwin A. Matteson and William P. Donald, Youngstown, Ohio, assignors to The Aetna-Standard Engineering Company, Youngstown, Ohio, a corporation of Ohio.

A new coil carriage is provided for handling the strip material of various diameters and to properly transfer the coils and then axially shift them as required.

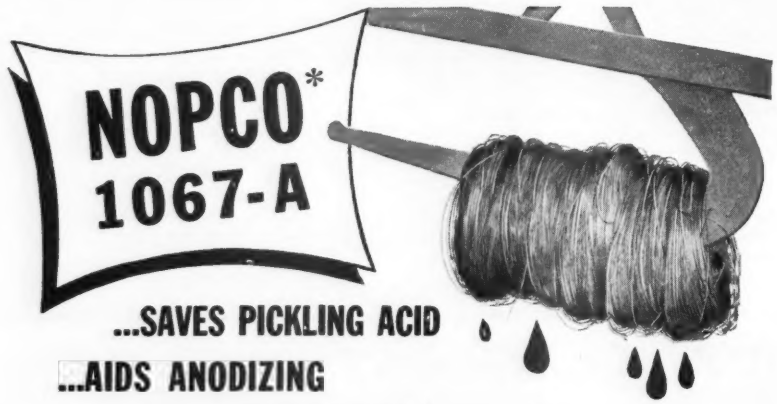
★ ★ ★

No. 2,568,055, CUSHION ASSEMBLY WITH AUXILIARY REINFORCING SPRING, patented September 18, 1951 by William A. Clark, Detroit, Mich., assignor to L. A. Young Spring & Wire Company, Detroit, Mich.

Auxiliary or supplemental wire spring elements may be introduced and mounted in desired locations in an auto seat structure without disassembly of the upholstery and without damage to it.

★ ★ ★

No. 2,568,303, APPARATUS FOR DRAWING WIRE, patented September 18, 1951 by Adolph H. Rosenthal, New York,



In all of these important operations—pickling, anodizing, phosphatizing—the remarkable ability of Nopco 1067-A to reduce surface tension in mineral acid solutions leads to definite economies, improvements in processing, and better final products.

PICKLING—Addition of Nopco 1067-A to the pickling bath—

(a) reduces loss of acid solution through carry-over to the rinsing tank by 30% to 40%;

(b) reduces acid contamination in operations following pickling—helping to increase die life;

(c) effects faster and more uniform penetration of oxide scale—assuring clean, *smooth* metal surfaces after pickling.

In general, 0.1% of Nopco 1067-A on the weight of the acid solution gives outstanding results.

ANODIZING—Use of Nopco 1067-A in the anodizing bath not only affords high drain-off of the acid solution, but results in "taming" of the bubbles caused by air-blast agitation. Bubbles are reduced in size and they burst gently, minimizing spray. In some instances, need for costly lead-lined exhaust fans has been eliminated.

PHOSPHATIZING—Addition of 0.1% of Nopco 1067-A to "Bonderizing" chemicals lowers surface tension substantially. This results in exceptionally even spreading which promotes excellent over-all adherence of paint or enamel to ferrous metal.

Mail the attached coupon today. We'll send you promptly full information about Nopco 1067-A —the unique wetting agent which not only assures improved products but saves money, time, and labor in all types of acid treatments.

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N. Y., assignor to Scophony Corporation of America, New York, N. Y., a corporation of Delaware.

The assembly includes a rigid support with a tubular member of ferromagnetic material of the type which under the action of varying magnetic fluxes exhibits magneto-striction effects, projecting from this support, a wire drawing die holder mounted in the member spaced from the support, and electromagnetic means for producing in the tubular member magneto-striction effects to forcibly reciprocate its projecting end essentially in a direction parallel to that of drawing a wire.

★ ★ ★

No. 2,568,329, FURNITURE CONSTRUCTION, patented September 18, 1951 by Lee M. Eldridge, Dundalk, Md., assignor to Custom Upholstering and Carpet Company, Inc., Baltimore, Md., a corporation of Maryland.

A suspended metal cradle is provided for supporting the bottom webbing and wire springs, of a seat construction, from the rails of the furniture frame.

★ ★ ★

No. 2,568,775, APPARATUS FOR FEEDING AND CUTTING COILED MATERIAL, patented September 25, 1951 by John S. Stull, Chicago, Ill., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York.

Wire wound in a helix is fed to a severing device, severed to form an annulas and the annulas assembled onto an article, which is then deformed to retain the annulas thereon.

★ ★ ★

No. 2,568,847, METHOD OF COATING WIRE-WOUND ELECTRICAL RESISTORS, patented September 25, 1951 by Alden J. Deyrup, Westfield, N. J., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delaware.

Where the resistors have ceramic cores, the method comprises alternately applying and firing at least three successive coats of vitreous enamel on the wire-wound core, firing the first coat at a time and temperature to produce a smooth, glossy surface, firing every additional coat, except the last coat, at a time and temperature to sinter and bond the enamel particles to form a solid, porous surface, and firing the last coat to form all of the applied enamel into a smooth, even, glossy coating.

★ ★ ★

No. 2,568,945, ARMATURE WINDING MACHINE, patented September 25, 1951 by Peter J. Burdulis, Delhi, Calif.

The wire is fed from a stationary guide head, with new drive mechanism to support the armature and to actuate it through a winding or wire-receiving cycle in adjacent cooperation to the guide head.

★ ★ ★

No. 2,569,097, METHOD OF COATING FERROUS METAL WITH ALUMINUM OR AN ALUMINUM ALLOY, patented September 25, 1951 by Howard L. Grange, Darlington, Wis., and Dean K. Hanink, Birmingham, Mich., assignors to General Motors Corporation, Detroit, Mich., a corporation of Delaware.

A salt bath is provided composed of KC1 37 to 57%; MaC1 25 to 45%; Na_3 $A1F_6$ 8 to 20% and $A1F_3$ 0.5 to 12%, actuated by aluminum in contact with the fused salt which is at a temperature within the range of about 1250° F. to 1600° F. and ferrous metal having a temperature at least as high as the melting point of the coating metal while in the bath, then immersing the ferrous metal in a molten bath of the coating metal while the metal is at a temperature at least as high as the melting point of the metal coating bath and thereafter removing the coated metal from the metal coating bath.

★ ★ ★

No. 2,569,195, METHOD OF INSPECTING WIRE-DRAWING DIE CONTOURS, patented September 25, 1951 by John G. Quetsch, Jr., Garfield Heights, and Joseph T. Weir, Cleveland, Ohio, assignors to The American Steel and Wire Company of New Jersey, a corporation of New Jersey.

The method employs a sheet of uncured rubber, which will flow, when sufficient heat is applied, into and through the small-diametered portions of the die holes to form impressions.

★ ★ ★

No. 2,569,292, WIRE WINDING MACHINE, patented September 25, 1951 by Richard C. Dehmel, Short Hills, N. J.

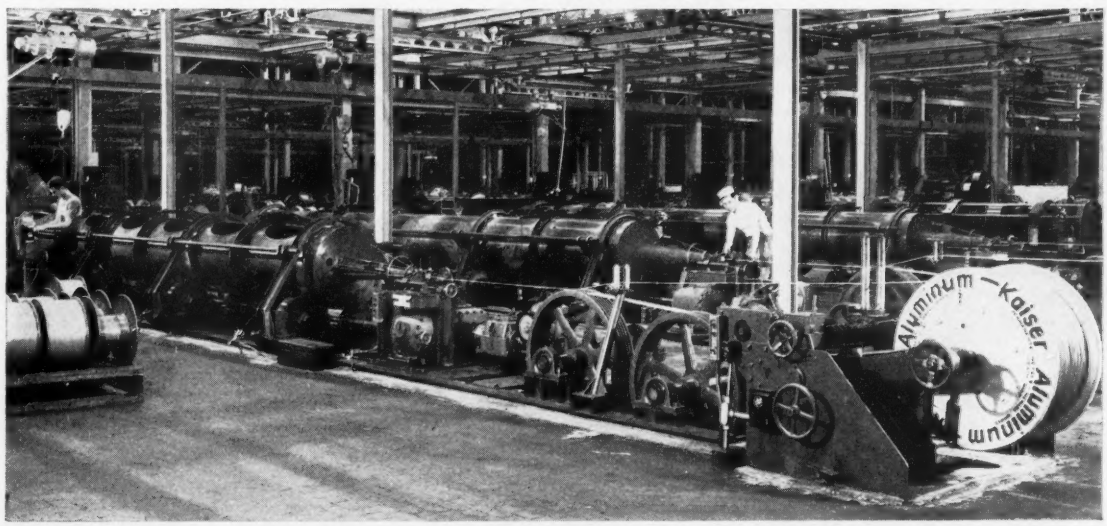
Conductor wire is wound around a flat core blank by this machine. There are 10 claims.

★ ★ ★

No. 2,568,326, COMPENSATING HAIRSPRING, patented September 18, 1951 by Ernest Dubois, La Chaux de Fonds, Switzerland.

NEW 22" SPOOL 750 RPM TUBULAR STRANDER

HYDRAULIC LIFT REEL STAND — INFINITELY VARIABLE TRAVERSE AIR CONTROLLED
DOUBLE DRUM HAUL-OFF WITH LINK BELT P.I.V. — AIR OPERATED BRAKING SYSTEM



HMT — Hughesville Machine & Tool Company — Established 1846 — Wire & Process Machinery

Hi-Efficiency

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HUGHESVILLE, PA.
Phone: 129-A

A compensating hairspring is provided of an elasticity at least equal to that of tempered steel hairsprings, and constituted by an alloy such that the strict compensation obtained by association with a mono-metallic balance-wheel of the uncut nickel type is ensured by the aid of the alpha-iron-nickel complex, the nickel being in a proportion of 24 to 27 per cent, with auxiliary additions composed in such a way that the temperature permitting perfect fixing to be obtained is at the maximum 550 degrees centigrade, constituted by an alloy the composition of which is included between the following limits: nickel 24 to 27%; carbon 0.20 to 0.7%; columbium 1 to 5%; manganese 0.5 to 1%, the remainder being iron.

★ ★ ★

Book on Materials Handling Offered

A 24 page booklet titled "The How Book of Cost Cutting Materials Handling" is now available from the Philadelphia Division, **Yale & Towne Manufacturing Company.** A revised edition of a previous booklet printed in 1947, the "How Book" was prepared under the guidance of Dr. V. S. Karabasz, Professor of Industrial Management, Wharton School, University of Pennsylvania.

A large portion of the "How Book" is concerned with basic background material covering types of skids, pallets and other industrial handling tools. Most of the balance covers a comprehensive plan for evaluating present handling methods through an engineering analysis much like a time and motion study.

Enclosed in the book are several charts and summary sheets for making a materials handling analysis. More sheets are available. For a copy of the "How Book of Cost Cutting Materials Handling" write the Yale & Towne Manufacturing Company, 11,100 Roosevelt Boulevard, Philadelphia 15, Pa.

★ ★ ★

Inco Featuring Versatility of Nickel Alloys

Keynote of International Nickel's booth (No. A-328) at the National Metals Exposition in October was the versatility of nickel as an alloying element. There were over 3,000 commercial alloys containing nickel, from which it is possible to select one that will meet any reasonable combination of requirements. From ordnance and supporting industry, examples were shown of established applications of nickel in cast iron, steel and stainless steel and in nickel silver, 70-30 and 90-10 cupro nickel. A wide variety of successful applications of the new engineering material Ductile Iron was displayed in thin and thick sections.

Platinum metals will be exhibited. Uses of platinum for defense and essential industry is so important and these applications have increased to such an extent that its use for jewelry is restricted.

Members of the Technical Staff were at the booth to give service and to assist manufacturers to meet these changing times.

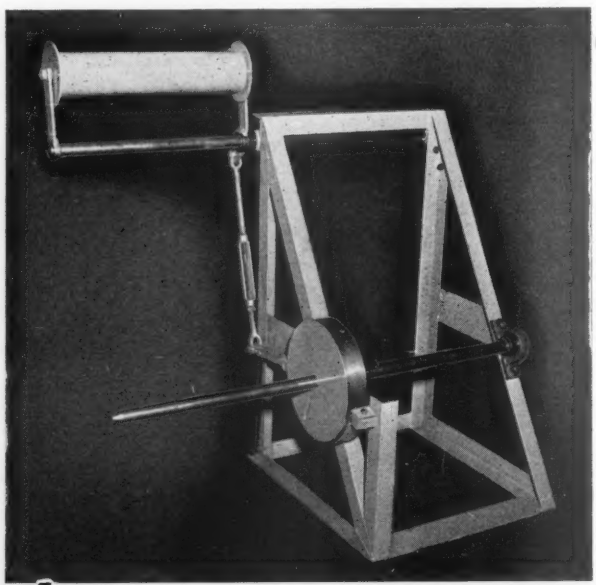
★ ★ ★

How Development and Research Have Created New Markets for Nickel Base, Nickel Chromium and Chrome Iron Alloys

(*Continued from page* 1046)

on a bull block. Thus, you can see the tremendous amount of work involved and the extra equipment required to produce a wire of this type.

★ ★ ★



Use **FEDERAL PAYOFFS** *for Best Results!*

They're ruggedly built and designed for today's versatile requirements out of actual mill experience. Features:

AUTOMATIC TENSION BRAKE
HANDLE REELS UP TO 30" DIAM.
And they're priced right!

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DOUBLE TAKE-UPS

Federal Manufacturing Co.
SPECIAL WIRE MACHINERY
236-240 *Hall Avenue, Wallingford, Conn.*

To speed up the development of applications in normal times, we maintain large stocks of finished wire rod and strip so that customers can make pilot runs on new applications.

★ ★ ★

While our alloys are used to replace carbon steel, plated steel, and copper base alloys, we don't depend merely on replacing other metals for our new business. Very frequently a new product, new gadget, new control is being manufactured that would be impossible without our alloys. This ever-growing field is of greater importance to us because here the fundamental properties of our alloys are a must.

★ ★ ★

Material cost is a smaller part of the final cost in wire and rod products; whereas, on sheet and plate and other rolled forms of metal, material cost is usually the greater part of the final costs. For the above reason, the best corrosion or best heat resisting metal warrants far more consideration when the part is made out of wire rod.

★ ★ ★

Because wire and rod products are often used at critical points where corrosion or loss of strength due to sub-zero temperatures or extra high temperatures will cause failure of a complete unit, it is most important that the best material available be used. This fundamental is frequently our best salesman and can best be illustrated by springs used at elevated temperatures. Metals that don't have the resistance to relaxation of Inconel or Almet 302 Stainless just can't be considered. Another similar example is industrial wire cloth where corrosion of the wire would make openings in the cloth so large that it would be unsuitable for filtering.

★ ★ ★

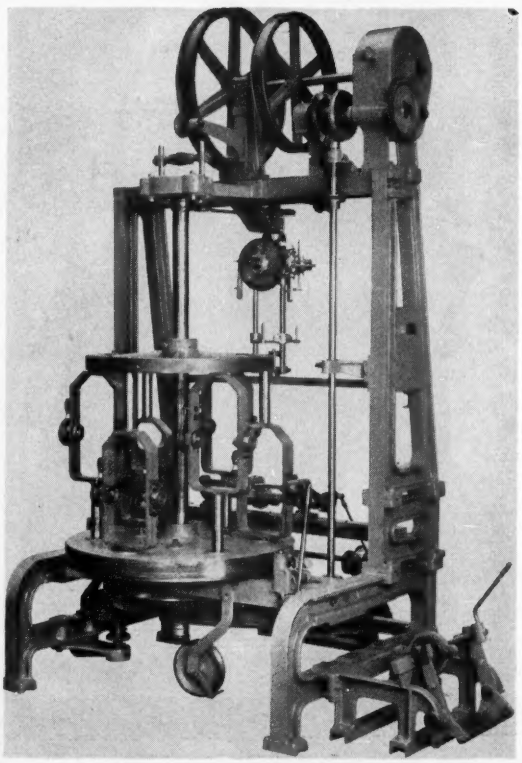
A check on Stainless Steel at this time would not be complete without a quick report on the use of the Signal Corps' spiral four cable that is now using large quantities of .015" diameter Type 302 Stainless Steel wire. This program, when it gets in full swing the first quarter of 1952 will require one million pounds of .015" diameter Type 302 Stainless Steel wire per month.

★ ★ ★

Type 302 Stainless is used because of its high strength, 300,000 psi tensile, plus its corrosion resistance and its low permeability. The wire as produced has a magnetic permeability under two.

★ ★ ★

The spiral four field telephone cable now used by the Signal Corps for front line field service consists of a stranded copper coil which carries the messages and this is covered with a polyethylene in a 16 strand braid of 0.15" diameter Type 302 Stainless wire which covers the polyethylene coating. The Stainless wire actually carries the load of the cable when it is strung up on poles and its low magnetic permeability acts as a shield for preventing interference. The Stainless strand is then covered with a PVC coating and all of this results in a very flexible yet strong cable that



Pourtier Assembling Machines

OF INTEREST TO CABLE MANUFACTURERS:

OUR VERTICAL ASSEMBLING MACHINE—WITH DE-TORSION

IT IS:

- noiseless because driven by V-belts;
- highly productive because handles large drums;
- safe because of friction and automatic stop motion;
- easy to operate because equipped with a regulated traverse; and
- efficient because 3 papers or 1 cotton can be applied after the assembling operation.

Has Haul-off Capstan 24" Diam.
Built with 4, 6, 8, 12 and 18 Bobbins.

Inquire about prices and delivery.

POURTIER MACHINES

153 Rue Gallieni

ROMAINVILLE • SEINE, FRANCE

will withstand a 650 pounds breakage test. In addition to the breakage test, the cable must withstand the heat of 150° F. and the bending test at minus 700 F°. without cracking. This enables the Signal Corps to use the cable any place in the world regardless of fungus growth, heat, or cold. They can store the cable without fear of deterioration.

★ ★ ★

Cable is made in one-quarter mile lengths and connected with brass couplings and only requires single quarter turn twist. By using loading coils every half mile to a mile which are placed at the coupling, they can maintain full signal strength up to 150 miles. At 150 miles, they install a repeater station that maintains the same high fidelity signal strength.

★ ★ ★

This has been one of those applications where you supply samples and information for a number of years and then something breaks so big that 13 other wire drawers have had to come into the picture to supply the need.

★ ★ ★

Development and research has created new markets for our alloys by our sitting down and talking with our customers about the cost of various parts of their products that are being plated. The replacement of plated metal parts that had to be rack plated with our metals has become a big business. The labor required for the racking of intricate parts for plating is mounting all the time with the higher and higher labor costs. I have tried to pick some of the more interesting ones with which you are familiar. For instance, watchbands are a good example of how it was not only cheaper to make them from Almet 302 Stainless wire but the product is far better. There is 5¢ worth of wire in this type of watchband; whereas if it were made out of steel, the rack plating cost alone would almost equal that figure.

★ ★ ★

The top rod on your automobile antenna is another good example of where it is cheaper to use Type 302 Stainless Steel rods .100″ diameter by approximately 30″ long rather than to use high carbon steel rods and then plate. The 302 antenna rods have a tensile of 260,000 psi and are more than stiff enough to take any permanent set in this type of service. There is no plating to chip or peel and the rod maintains its silver-like appearance indefinitely.

★ ★ ★

Very likely, the toast you had for breakfast this morning was done on an automatic toaster that used guard wires made of Monel. It used to be that they used plated steel wire here but the moisture from the bread quickly rusted and corroded these wires to a point where the toast would stick. Now that they use tough strong Monel wire they can reduce the diameter which also makes less of a mark on the toast and have free sliding action of the toast on the guard wires.

★ ★ ★

The shoes you are now wearing have the lining and some parts of the leather stapled together with

the ROYLE SPIROD* EXTRUDER

A completely new and different concept of electrically heated extruder designed for plastics materials. . . . Higher operating temperatures. . . . Lower operating costs. . . . Radiant heated. . . . Zoned as required throughout cylinder and head. . . . Even and controlled cooling. Royle Spirod Extruders have been field-tested and their stamina proved. Check these features that assure trouble-free operation —positive results.

- Heavy steel members without flanges
- Spirally installed rod type heating elements provide faster and more even distribution of heat
- Radiant heat provides steadier temperatures
- Complete insulation reduces heat loss with substantial power savings
- High watt capacity heating elements provide faster heat at lower cost
- Long life heating elements provide high and sustained operating temperatures
- Separate heating zones controlled by proportioning instruments
- Simple installation should replacements become necessary

*Patent Applied For

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Monel staples. It used to be that they used plated steel staples, but the moisture from the feet would corrode out the steel staples and they would break allowing the lining to come loose. In addition, the plain steel staples would discolor the light colored ladies' shoes.

★ ★ ★

Parachute strap springs are another good example of where it is cheaper to use solid Stainless Steel spring wire .015″ diameter than it is to use plated music wire, which would not have the corrosion resistance required for such an application. Neither would it have the non-magnetic properties and, above all, would not have the good ductility at sub-zero temperatures which are needed for parachute straps. For instance, an aviator jumps out at 40,000 feet in 50° below zero and the music wire springs would break when the chute opened; whereas, 18-8 Stainless Steel due to its 8% Nickel content has just as good ductility at sub-zero temperatures as it does at room temperature.

★ ★ ★

Monel washer retaining screws for your water faucets is another good example of where plated or copper base alloys prove to be more expensive than Monel. Comparative corrosion tests have been run on Monel and other metals in most municipal water supply plants in cities with populations of over 100,000. These tests prove that Monel will stand up longer than any other commercially available metals, yet costs approximately the same as copper base alloy screws for plated metal screws and have only a fraction of the life of Monel.

★ ★ ★

Inert gas welding wire is a good example of how a great new market can be developed for fine wire. The sizes of wire used for inert gas welding are mostly .035″, .045″ and .062″ diameters with some larger sizes being used. It is expected in the long run that inert gas welding will replace much of the present shielded arc welding or submerged arc welding. Basic fundamentals of inert gas welding are the same as arc welding with the coated electrodes, except the supply of metal is continuous and the inert gas, helium or argon or a combination of both acts as a protection against oxidation of the metal. Movement of the wire and the flow of inert gas around it is controlled by a trigger mechanism on the welding torch, and the wire itself coming in contact with the work completes the circuit, causing an arc. The wire feeds off the reel through the feed rolls where it picks up the current from the contact and thus through the rubber hose and into welding torch. It is faster and uses less metal than the coated electrodes used in the manual arc welding method. There is no scrap as there is with the electrodes that are coated where your operator throws away about 3″ of stub electrode.

★ ★ ★

Inert gas welding is a good example of how close wholehearted cooperation between the companies developing the process and the wire manufacturers have created a great new market for wire. Success of the

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Wire Netting Machines for Chain Link, Hexagonal Mesh, Poultry Netting, Field Fence. Crimping, Barb Wire and Staple Machines. Spring Coilers. Spring End Grinding Automatics. Loop Benders. Upholstery Spring and Wire Mattress Machines. Wire Nail Machinery. Chain Formers. Chain Welders. Straightening and Cutting Machines. Multi-Slide Wire and Strip Forming Machines. Special Machinery for the making of Paper Clips, Lock Washers, Bale Ties, Key Rings, Tin Openers, Wire Bag Ties, etc. Automatics for Flexible Metallic Tubing.

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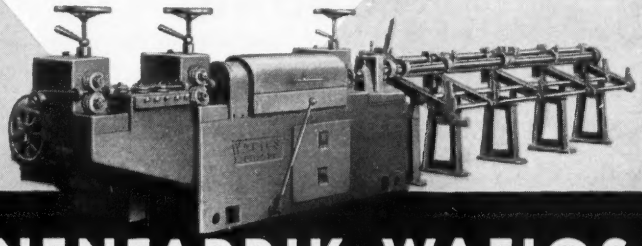

MASCHINENFABRIK WAFIOS

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inert gas welding method depends upon a closely controlled wire quality that must be consistently uniform in all its properties.

★ ★ ★

Selection of special analysis is a first requirement so that the resulting weld will have the metallurgy required for the service conditions involved.

★ ★ ★

Special cleaning of the wire is required to promote uniform electrical contact and thus maintain a steady arc at the weld.

★ ★ ★

Special uniform temper is required for proper rigidity for feeding through the long rubber hose.

★ ★ ★

Special cast control so that the wire coming out of the welding gun will not have a spiral, but be straight and produce a straight welding bead. Special spooling required so that the wire is free from kinks, laps and tangles or anything else that might cause irregularities from feeding of the wire or slippage through the feed rolls.

★ ★ ★

Special expendable spools are required since the welding industry will not bother with the return of spools.

★ ★ ★

Special selling is also required for this product since normally a wire mill doesn't call on welding shops.

★ ★ ★

Again we have created a new market for practically all of our alloys in a growing industry (the inert industry) where the potential is very large. The development of inert gas welding wire is, likewise, a good example of how such a very special job can best be done by a small company who recognizes the potential and has the flexibility to handle the metallurgical, mechanical, production and selling problems involved.

★ ★ ★

In closing my talk, I would like to get a simple message across and I am assuming that you all have good healthy businesses at the present. My message is for the future:

"DEVELOPMENT AND RESEARCH—YOUR BEST INSURANCE FOR FUTURE BUSINESS."

★ ★ ★

Before leaving the platform, I have been asked to comment on the availability of Nickel base, Nickel Chromium Iron and Chromium Iron alloys. The M-80 Government restriction order covers the uses of these alloys. Any alloy containing more than 1% Nickel is very much restricted and the end use must be approved. On all such orders with alloys containing more than 1% Nickel, it is required that the actual order be submitted to NPA on a monthly production sheet of a producer before production can be started. For instance, orders coming in between now and November 10th will be submitted to NPA on the January melt sheet and along about December 15th to the 20th the producer will know whether NPA have approved this for production. In their approval of these production schedules, the Metallurgical and Conservation Branch of NPA regularly downgrade some of the orders

COILING POINTS

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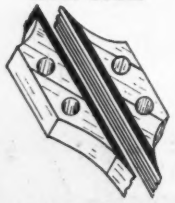
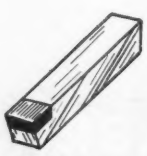
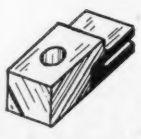

INTERMEDIATE AND FINAL GUIDES

PITCH TOOLS


CUT-OFF TOOLS


TORSION COILING POINTS

TORSION ARBORS

FEED ROLLS

to lower Nickel contents or advise that a substitution can be used that does not contain Nickel.

★ ★ ★

Each month NPA advises each producer how much Nickel content is available for the orders they have submitted for approval. Each month this is less than the amount requested for the orders submitted and therefore, each order is cut back by a certain percentage and certain orders will be carried over to the following month's production sheet because of directives on essential applications where 100% of the order has to be produced.

★ ★ ★

You are naturally thinking—is the Nickel shortage going to get worse or can we expect some relief. Speaking from our own experience, it is going to get worse because for November we are getting 35% less Nickel than we got in September. The question then is—where is the Nickel going and here are some of the spots:

Jet engines require great quantities of Nickel for the heat resisting parts. Armor plate requires larger tonnages than normal because they now have to produce armor plate that will withstand sub-arctic temperatures and this requires higher percentages of Nickel. Government stock piling takes a large quantity. Atomic energy, H Bomb and other vital defense projects takes a large amount of nickel.

★ ★ ★

Naturally, our customers who can't get Nickel can't shut down their production lines so we have done our utmost to put our complete engineering and research facilities available to help them find substitutes. Type 430 Stainless Steel has become a workhorse and solved many of the problems with surprisingly good results. On many applications, the mechanical properties of Type 430 are equivalent to those of the 300 Series Stainless or other Nickel containing alloys. For example, many of the weavers on coal washing screens and other cleaning and filtering operations switched to Type 430.

★ ★ ★

For a number of heat resisting applications operating up to 1400° F., Almet 430 Stainless is being widely used AND IT EXHIBITS GOOD RESISTANCE to scaling and oxidation.

★ ★ ★

A number of automobile applications such as antennas, windshield wiper parts, carburetor needles and others where the 300 Series Stainless was formerly used are now being supplied by Type 430 Stainless and doing a satisfactory job as a substition. On many of these applications, we will return to the 300 Series Stainless when they are again available but 430 Stainless is the best substitute available.

★ ★ ★

The natural conclusion is how long will the straight Chromium 400 Series Stainless remain available with this great shift away from the 300 Series Stainless. Actually, no increased amount of Chromium is

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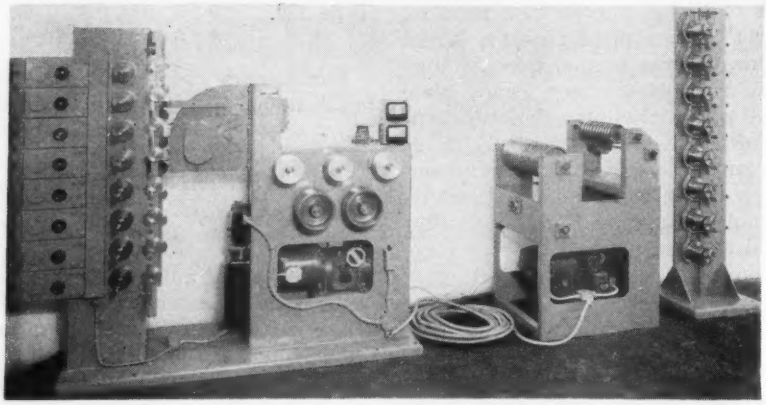

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FOR USE IN CONJUNCTION WITH ANNEALING PROCESS

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Six different wire feed speeds
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Type RA 7

M R+P SINCE 1870

involved since most of the shifts to 430 are from Type 302 Stainless where Chrome content was already 18% and actually 430 is 17% Chromium, so 1% of Chromium is saved. Furthermore, since all the melters are still getting 100% of the Chromium they got during their base period months, which is the average first six months of 1950, they are still able to maintain a high production rate. Actually, the pickling and annealing are greater bottlenecks in the production of 430 Stainless than the Chromium content.

★ ★ ★

Type 430 Stainless requires about twice as long to anneal as the 300 Series, so when the mill shifts from what might have been a 25% 400 Series Stainless—75% 300 Series to a 25% 300 Series and 75% 400 Series, the production picture—the annealing really becomes a bottleneck. All of the mills as a result are putting in additional annealing facilities to take care of this increased load which they expect will be with them for some time.

★ ★ ★

Stainless Steel wire industry is undergoing the greatest expansion in its history and I predict that it will be the most competitive part of the Stainless industry when the emergency is over. However, all of this competition will increase the demand for development and research and thus create even larger markets. My prediction to those of you here who buy Stainless Steel wire is that you will have plenty of Stainless Steel salesmen calling on you by the end of next year, if not before.

★ ★ ★

A new alloy that will help combat the Nickel shortage is a grade of Stainless Steel with the following composition—18% Chromium, 4% Nickel and 6% Manganese. This alloy is fully austenitic, the same as the 18-8 grade and has pretty much the same mechanical and physical properties. However, it only has half as much Nickel.

★ ★ ★

While you might think the following summary of the Nickel shortage to be a little facetious: There is no shortage of Nickel—it is just that the demand is abnormal.

★ ★ ★

Composite Insulated Wire Constructions Employing Polyethylene and Nylon

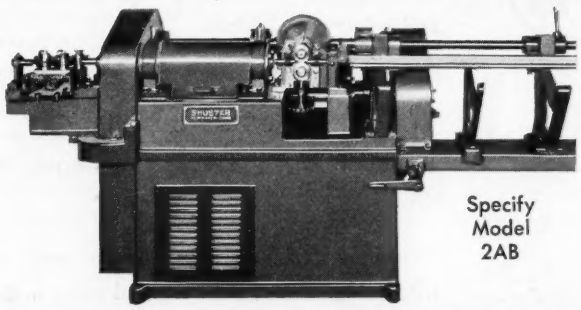
(*Continued from page* 1040)

resistance of polyethylene to abrasion and cutting was presenting quite a problem in radar and coaxial cables. Early in this work the need of a tough inert protective sheath for polyethylene was quite evident. The first experimental extrusions of nylon were very encouraging, and a research program was initiated to study further its usefulness in this field.

★ ★ ★

Difficulty was encountered, in this early work, in attempting to extrude nylon by techniques then in practice for other thermoplastics. It was found also that nylon jackets on cables of the larger diameters had a tendency, when sharply bent, to be cold-drawn on the outside and compressed on the inside. This cold-drawing was irreversible, and hence repeated flexing would cause the formation of a collar. As a result of the difficulties encountered, investigation was continued on design of insulating tools and on improvements in extruding practice.

SHUSTER—famous for QUALITY Production



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THIS new model, with five gear-design straightening rolls, handles even badly twisted wire with ease. And square and rectangular wire may also be straightened and cleanly cut to exact lengths.

Other SHUSTER features that assure high-speed, quality production are:

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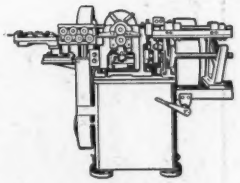
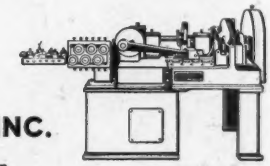


FLAT STOCK STRAIGHTENERS



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The method finally adopted is one in which a tube of nylon is extruded over the primary dielectric and pulled down to the desired thickness by regulating the speed of the wire passing through the guide-tip. When this stage of development was reached, nylon was introduced to the insulated wire trade.

★ ★ ★

Chemistry: Nylon is a generic name for a family of polymeric amides which are thermoplastic in nature but of relatively high melting point. The types of nylon which are most adaptable to wire coating are generally the condensation products of hexamethylene diamine with adipic acid or sebacic acid.

★ ★ ★

Properties: Nylon's principal function in wire and cable design up to the present time is that of a protective sheath. Nylon is not outstanding in its electrical properties but has found limited use as a primary insulation in magnet wire, blasting wire, etc. In small wire applications its excellent abrasion resistance and its high film strength in thin coatings have made it a versatile engineering material. Other important properties contributing to its usefulness are its stability at high temperatures, its low-temperature flexibility and its chemical resistance. Its failure to support growth of fungus has been of prime importance in its adoption in many military applications.

Applications

We have discussed the history, some general properties and events leading to the expanding use of polyethylene and nylon in insulated wire. Now let us conclude with some illustrations of how these materials are used in practical application.

Low Tension, Radio Hookup and Instrument Wire

Radio hookup wire is perhaps the earliest commercial development of a composite insulation employing nylon as a protective jacket over a primary dielectric. During World War II the shortage of braiding and lacquering facilities, coupled with the need for an improved wire for low-tension radio and instrument wiring for ships and aircraft accelerated the search for an alternative and superior coating.

★ ★ ★

The conventional low-tension wires in use at this time were manufactured to specifications JAN-C-76 and AN-J-C-48a. Briefly, these constructions consisted of a copper conductor insulated with polyvinyl chloride or polyethylene and mechanically protected with a fibrous covering. The braid was in turn coated with a saturant to seal out moisture and render it resistant to fungus and flame. Overall several coats of lacquer were then applied, to fill the interstices, prevent fraying and give a smooth slippery surface to facilitate wiring in ducts, conduit, etc.

★ ★ ★

With the development of satisfactory extruding techniques, it was found that a 6 mil jacket of nylon offered superior protection to that of the lacquered braid. The nylon jacket was far superior in resisting abrasion and cutting, did not support

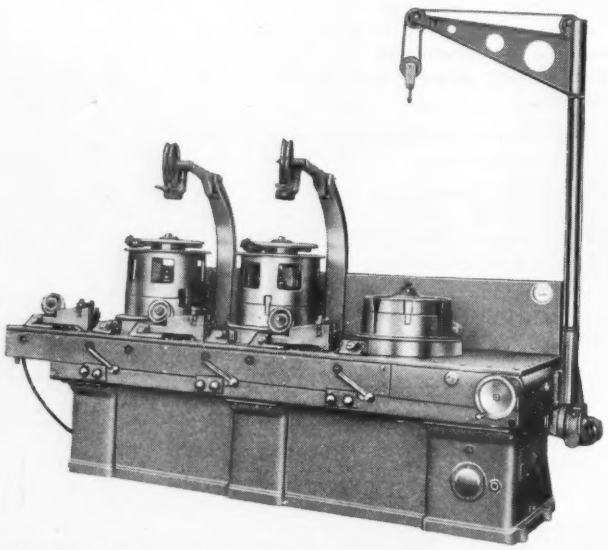
EW

Wire Drawing Machines, working on the dry or wet method (soap powder or by immersion) for iron, steel, copper, aluminum and other metal wires.

Metal Wire Cloth Weaving Looms (fly & mosquito nets, sieves, plastering work).

Automatic Straightening and Cutting Machines.

Machines for producing: Wire nails and wire tacks, rivets, iron & wood screws, small nuts, welded and non-welded chains, knotted chains, barbed wire, wire pins, safety pins, hair clips, spokes and nipples for bicycles, etc.



EMILIO WARTENWEILER

MILANO (Italy) Via G. B. Pergolesi, 18

growth of fungus and was lighter in weight and smaller in diameter.

★ ★ ★

For comparison take #20 A.W.G. radio hookup wire manufactured to specification JAN-C-76. Starting with conductor and primary insulation of the same weight and size, the lacquered braided type has a weight of 2.4 pounds per 1,000 feet of braid and lacquer, and an overall diameter of approximately 0.098. Replacing the braid and lacquer with a 6 mil wall of extruded nylon weighing 12 ounces per 1,000 feet and an overall diameter of 0.080, apart from the superior performance of this wire, the reduction in bulk and weight was a prime factor in having this new construction recognized by the Armed Services and written into the specifications as an alternate.

★ ★ ★

At this writing all MIL specifications are in the process of being revised. In these revisions all the Armed Services have included nylon as the preferred protective coating.

Infantry Field Wire WD-1, Army Signal Corps

One of the most outstanding examples of a composite insulation of polyethylene and nylon is Infantry Field Wire WD-1, developed by the Army Signal Corps.

★ ★ ★

This wire is a twisted pair assembly in which the individual conductors of approximately #21 A.W.G. consists of 7 strands, four tinned copper and three galvanized high-carbon steel, concentrically stranded, which has roughly 65% of the conductivity of the same stranding made entirely of copper. The individual conductors have an extruded insulation of about 19 mils of polyethylene protected by an outer jacket of nylon averaging 6 mils. The two single insulated and jacketed conductors are twinned to complete the construction.

★ ★ ★

Under combat conditions this wire is subjected to severe mechanical abuse. It is necessary to pay the wire out from jeeps and planes and by other means, at high speeds, from reels or the special dispensers designed for the purpose. During this pay out it is subjected to high stress, it is snapped and whipped and pulled over rough terrain. Heavy vehicles of all types continually pass over it. It must be capable of being laid in swamps and across streams; it must be flexible in sub-zero temperatures and withstand continual baking in the tropical sun. Under all of these conditions it must perform its primary function of carrying messages.

★ ★ ★

The steel members of the conductors contribute the necessary tensile strength to permit pay out at high speed. The copper strands are, of course, for conductivity.

★ ★ ★

The low-loss electrical characteristics of polyethylene make possible the longest possible talking range with thin-wall insulations, which in conjunction with its low specific gravity are important weight and size reducing factors. Its low moisture absorption and low temperature

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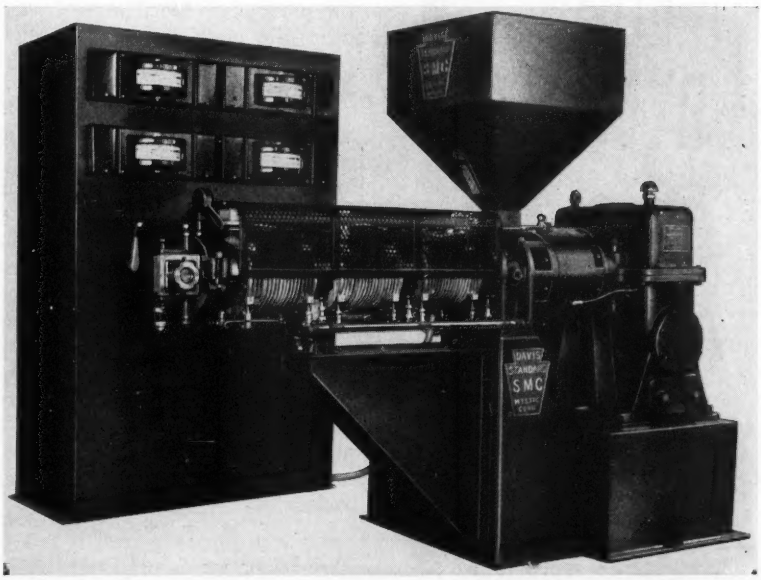

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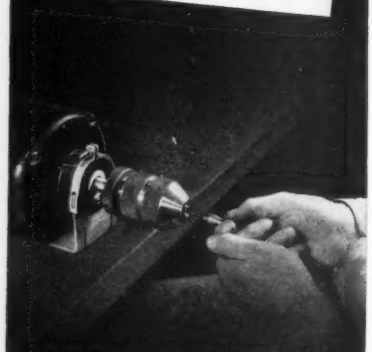

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ELGIN, ILLINOIS

flexibility permits its use under the wide range of weather conditions to which it is exposed.

★ ★ ★

The smooth, tough, thin wall of nylon protects the polyethylene from the severe mechcanical abuse to which it would be subjected during service. Its high heat-distortion temperature enables it to maintain its shape under conditions of high temperatures, and its thin wall allows it to maintain pliability at subzero temperatures.

★ ★ ★

The twisted pair construction ensures polyaxial flexibility necessary for the type of pay out used.

★ ★ ★

Miscellaneous Uses

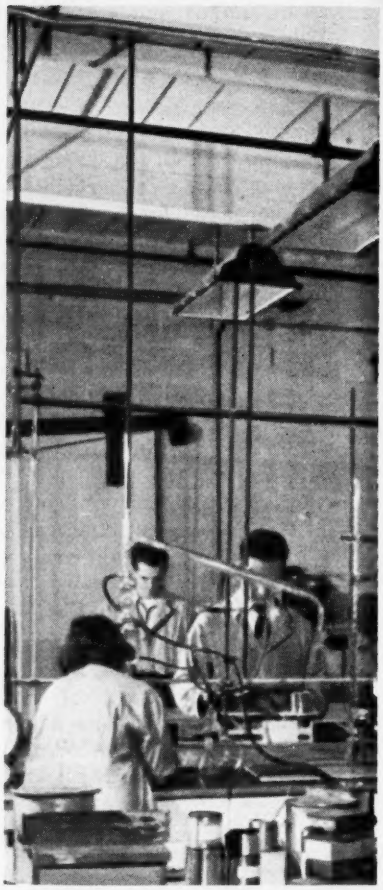
A new and important use for nylon is as a protective barrier. Certain types of hydraulic fluids and compounded lubricating oils contain ingredients, such as phosphate esters, and chlorinated organic compounds, which have a deleterious effect on polyvinyl chloride and polyethylene. Some of the fluids and oils soften the compounds by solvent action while others stiffen the jacket to the point of embrittlement by extracting the plasticizer.

★ ★ ★

Conditions of this type exist in planes and certain types of vehicles where the wiring runs close to the pumps and engines and comes in contact with the fluids through leaks, seepage, etc. When the protective sheath is thus broken through the fluids run through the breaks and travel by capillary action between the jacket and primary dielectric, or between the dielectric and the conductor. The fluids travel the entire length of the wire or cable and in a relatively short time impair its electrical properties and finally render it useless.

★ ★ ★

As a remedy for this condition, a thin extruded jacket of nylon over the cable has been found to give the necessary protection without any other change in the cable design. Nylon was a happy solution to the problem, especially for coaxial cables in which the balance of electrical properties is dependent on the physical dimensions. Fittings and



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The above photograph is one of many contained in an eight-page brochure describing our facilities to serve you. Write for your copy of the complete brochure!

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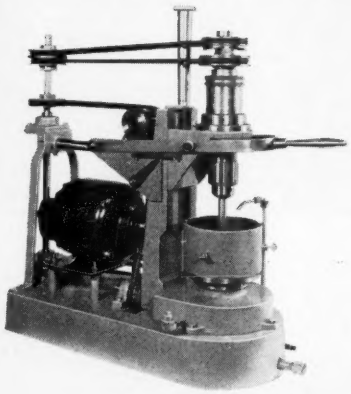

- Capacity up to 5" die casings.
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Also Distributed by Carboloy Company, Detroit, Mich., and Canadian General Electric Company, Toronto, Can., or your Die Room Supply dealer.

connectors have already been standardized for these cables, and the nylon jacket, not adding appreciably to the diameter, allowed the standard fittings to be used.

★ ★ ★

The interiors of many instruments, control panels, etc., have a high ambient temperature. The primary dielectrics used in these places would have, over a period of time, the plasticizer gradually distilled out becoming brittle and finally failing by cracking where the wire was bent, etc. Here again a thin jacket of nylon acts as a barrier, sealing in the primary, and its excellent heat resistance makes it suitable for most temperatures encountered.

★ ★ ★

It is hoped that the foregoing paragraphs have served to illustrate in general what polyethylene and nylon are, and some of the uses to which they are being put in insulated wire. The future applications of these resins in composite forms seem promising, especially in small wires where weight and size are of importance.

★ ★ ★

References

du Pont Polyethylene Bulletin
du Pont Technical Service Bulletins
Shackleton, J. W., Polychemicals
Bakelite Polyethylene Bulletin
Bakelite Kableitems

★ ★ ★

Appreciation is extended to the Office of Technical Information, Office of the Chief Signal Officer, for permission to refer to certain information in this paper.

★ ★ ★

"Wire Rope—So What?"

The current issue of Roperology Bulletin, issued by the **Macwhyte Company**, Kenosha, Wisconsin, contains an interesting article under the title above.

Regardless of the make of wire rope, this discussion provides wire rope users with information that will help them to get better service and to save money on wire rope through proper usage practices, lubrication and service records.

The article does not promote Macwhyte rope in particular, but will be found of value to anyone interested in keeping costs on these products at a minimum.

Copies may be secured by writing the company, asking for a copy of Roperology, No. 5134.

★ ★ ★

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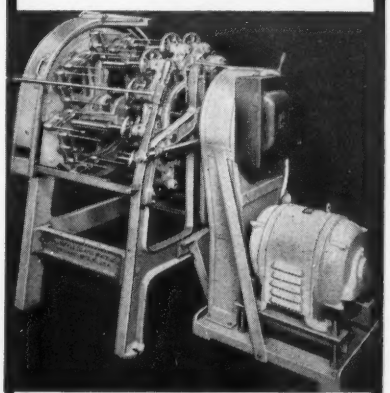
Your budgeting should be a long-term project . . . with the steady replacement of obsolete equipment. Check the *new, improved* HASKELL-DAWES twisters, ropers, layers, bunchers and stranders. This is the basis for *real* savings —savings earned through increased hourly output and lower unit costs. Born of eighty-two years specialized experience, H-D machines embody many new innovations that increase production efficiency.



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Specialists in Tin and Tin Chemicals
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High-Strength Copper-Silver, Copper-Iron, and Copper-Iron-Chromium Wire

(*Continued from page* 1038)

0.45 per cent magnesium does not strengthen the alloy sufficiently, while more than 0.55 per cent makes the hard-drawn wire brittle. Ductility, in this and all other wires in this series, was measured by the ability of the wire to be wound tightly about its own diameter in the manner of a "Western Union" splice. Only wires that could be spliced in this manner without showing cracks were considered to be satisfactory.

Melting

Alloys of the copper-iron-chromium series have not been produced in a commercial plant. However, some effort was made in the laboratory to make ingots of commercial size. The difficulties encountered earlier in melting and casting the copper-iron alloys were similar, but greater, when chromium was added to the alloy.

★ ★ ★

To get chromium recoveries of 85 per cent or over, it was essential that the iron and copper be heated to 1760°C. (3200°F.), or even higher, before the chromium was added. At this temperature, copper has a very low viscosity and vaporizes appreciably. In a magnesia crucible set in a high-frequency induction coil, the copper readily penetrated the crucible walls. The composition, however, could be controlled quite accurately.

★ ★ ★

The preferred method of melting in an induction unit was to melt the copper and iron together, without a slag cover, and superheat to approximately 1760°C. The melt was then deoxidized with a small addition of ferro-silicon, and the chromium added as ferro-chromium. Just before pouring, the magnesium was added as a master alloy of copper and magnesium containing 10 per cent to 15 per cent of magnesium. The lower magnesium alloy was easier to add. This method of melting was fairly satisfactory, if crucibles could be obtained that had been pre-fired at 1760°C. or higher. However, crucibles pre-fired at this temperature were not readily available.

★ ★ ★

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To overcome some of the difficulties associated with induction heating, a few melts were made in a Moore 'Lectromelt furnace. An attempt was made to use the double-slag method used in some ferrous melts, where melting is carried on under an oxidizing slag, which is changed to a reducing slag when the chromium is added. Unfortunately the metal produced was invariably gassy. Better results were obtained with a small amount of oxidizing slag, which was skimmed before the ferro-silicon and chromium were added. The metal was then tapped and magnesium added in the ladle. At the time these experiments were made, exothermic low-carbon ferro-chromium was not available. The ferro-chromium additions cooled the melt enough that an appreciable holding time was required after this addition and before tapping to regain the pouring temperature. This holding time allowed a somewhat unpredictable loss of chromium and, likewise, some variation in the magnesium recovery. The experiments were limited in number, but considerable progress was made. The metal could be cast from the ladle into seven-inch-square, cast-iron molds provided with a hot top, and sound ingots obtained, although the surfaces would have required scarfing before they could have been forged or rolled. We believe that this method of melting could be worked out to produce good forging ingots and, possibly, good wire bars. Work was suspended before this was fully proved.

★ ★ ★

Fabrication

Once good ingots are obtained, the alloy can be hot forged, hot or cold rolled, and swaged without difficulty. Wire drawing, although offering more difficulties than for the copper-silver or copper-iron alloys, can be accomplished successfully. As with the copper-iron alloys, best properties in the hard-drawn wire were obtained only after a particular sequence of aging and drawing operations.

★ ★ ★

The wire produced experimentally from a copper-iron-chromium-magnesium alloy had a resistance to corrosion in a mild industrial atmos-

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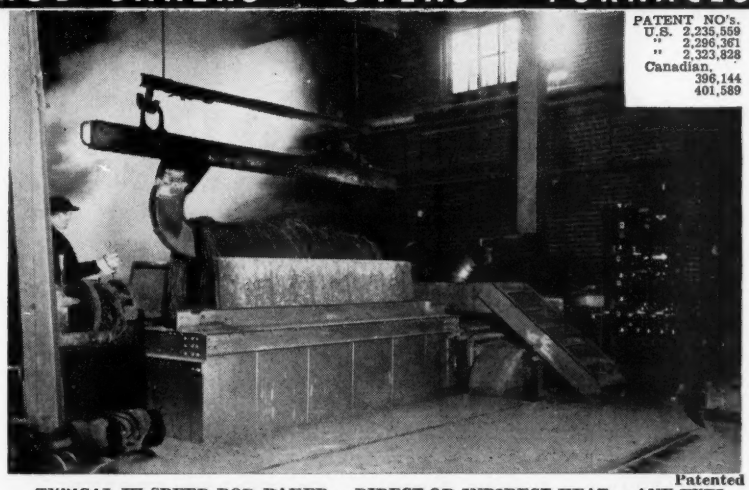

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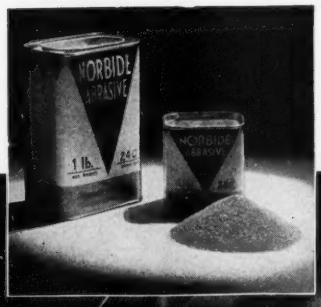

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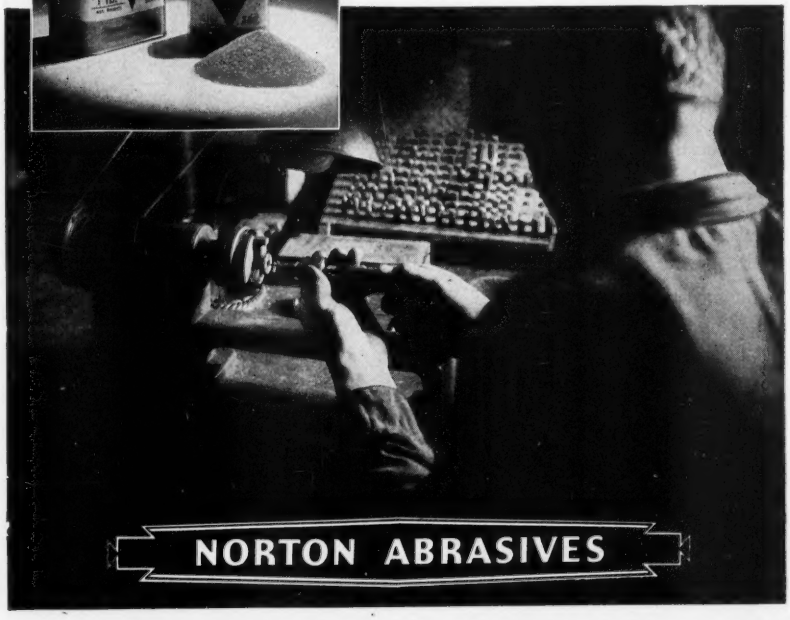

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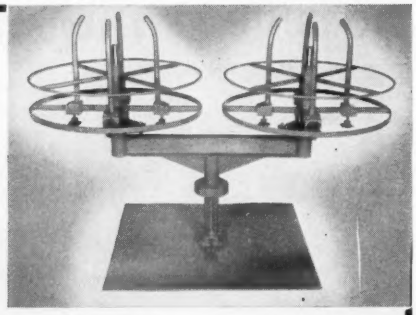

1) HEAVY DUTY DOUBLE REEL, 2) TILT TYPE, 3) SINGLE REEL.

Engineered by men experienced in all phases of wire working, NORSHOLM REELS embody advanced design features that assure increased production. Are rugged and precision made, built for endurance and high efficiency. Models vary from small single reels for light wires to large reels for 500 lb. coils of wire. All are ball-bearing equipped.

With the HEAVY DUTY DOUBLE REEL, shown above, greater yield from wire equipment is possible. As the wire is pulled from one reel, the other is loaded, eliminating down-time. Foot pedal allows reel to index 180° to make ready for new coil.

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phere at least as good as that of pure copper wire. It had a combination of tensile strength and electrical conductivity comparable to that of commercial copper-clad steel used for communications wire. Similar alloys with silver instead of magnesium could be made at a higher cost.

CONCLUSIONS

1. It has been demonstrated that it is possible to make copper-silver and copper-iron alloy wire in commercial plants and using standard brass mill equipment.

2. An alloy of copper-iron-chromium-magnesium has been developed that could provide the Signal Corps with an alternate material that could be used for open communications wire to replace copper-clad steel in an emergency. In normal circumstances, however, there would appear to be little incentive to do so, since more copper is used than in making copper-clad steel.

3. A very high-strength wire composition has been indicated in the copper-iron-chromium-nickel field that would be expected to have excellent corrosion resistance, but generally uninteresting electrical properties.

4. A wire material of high strength and fairly good electrical conductivity with unusual stability at elevated temperatures has been produced from a copper-iron-chromium-silver alloy.

5. A wide selection of other quaternary additions to a copper-iron-chromium base alloy showed no promise of producing wire with properties to equal those found for the three alloy compositions selected here.

★ ★ ★

Testing of the Cu-Fe-Cr alloys containing nickel and those containing silver was incomplete. Therefore, it is probable that the best properties obtainable from these alloys have not been attained. It was found, however, that these alloy compositions did not have the narrow critical range of the alloy with magnesium. Therefore, they should be easier to produce than the copper-iron-chromium-magnesium alloy. For certain purposes, their special characteristics may make these new alloys very desirable.

★ ★ ★

Chemicals and Processes Described in New Bulletin

The American Chemical Paint Company, Ambler, Pa., has published an 8-page technical service data sheet—No. P-100-21—that provides a quick reference list of metal protective and paint bonding chemicals and processes of their company.

The different products, methods of application, equipment and their uses are presented therein and copies of this Data Sheet will be sent upon request.

★ ★ ★

Catalytic Combustion of Atmospheric Contaminants in Effluent from Wire Enameling Ovens

(*Continued from page* 1055)

The main reason for the catalyst inactivity during Test No. II was considered to be that the thickness of the catalytic element was not great enough for the oven effluent to have time of contact with the active catalytic surface. The temperature of the oven effluent was only slightly below the required initial temperature of 260 C (500 F). The Combustible Gases, Per Cent L.E.L. for the nylon enamel was lower than for the oleo-resin enamel. Again, the test results show the importance of making chemical tests on the effluent of each new installation.

★ ★ ★

For Test No. III a catalytic element with a thickness of 2½ inches was installed. As indicated by the results there was a considerable reduction of the atmospheric contaminants in the oven effluent. Catalytic activity was first indicated, before the chemical analyses were made, by the temperature rise across the catalytic element. The temperature rise due to the catalytic combustion was 128 C (230 F). *See page* 1055

★ ★ ★

The Total Particulate Matter was reduced approximately 95%, indicating that all or most of the solid material in the oven effluent was combustible, and under the operating conditions was burned or incinerated, leaving little residue. It should be noted that the enamel usually exhausted from the wire enameling oven condenses on the piping of the exhaust system. This condition becomes a firehazard and must be removed periodically. The piping after the catalytic elements should remain relatively free from enamel deposits, resulting in decreased expenditure for maintenance.

★ ★ ★

Total aldehydes were reduced approximately 85%. This is a considerable reduction of these atmospheric contaminates. To test the individual's reaction to the oven and stack effluents, a respirator face piece was connected to the sampling pipe and the individual asked to

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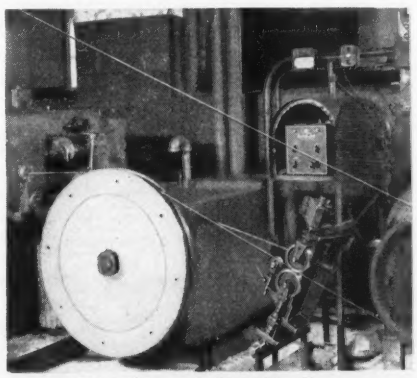

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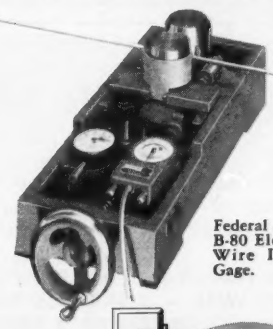
Costly variations are eliminated by Federal Continuous-Measuring Gages — modern control systems which automatically keep your wire diameter or insulation thickness "on the beam". With these gages, you can hold to the required limits without running into the danger zone. You save copper and/or insulating material, you get a more uniform product, you avoid reject footage. These advantages are being demonstrated by Federal Continuous-Measuring Gages in major wire companies today! For complete details, write Federal Products Corp., 2810 Eddy St., Providence 1, Rhode Island.



Federal Model 493 B-80 Electricator Wire Insulation Gage.

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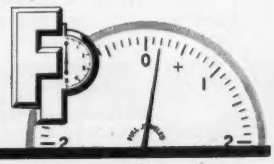

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ELECTRICAL WIRE & CABLE DESIGN ENGINEERS

In New Jersey positions are now open with a large insulated wire and cable manufacturer for experienced engineers. They should have practical knowledge of rubber, plastic, paper and varnished cambric power cable manufacture, in addition to a thorough understanding of applicable specifications and design principles. Supervisory experience preferred.

Write stating age, education, experience and salary desired.

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engineering and development laboratory

A position is now available for a supervisor of an insulated electrical wire and cable laboratory — with large manufacturer in New Jersey.

Must have experience in design, development, manufacture and research on rubber, paper, plastic and varnished cambric power cables. Administrative and supervisory experience essential.

Write stating age, education, experience and salary desired.

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inhale. The oven affluent was so irritating to each individual that the face piece had to be removed before making one complete inhalation. With the stack effluent, each person was able to inhale 3 to 4 times before it was necessary to remove the respirator face piece.

Summary

This investigation in the use of catalytic combustion of the effluent from wire enameling ovens indicates that there can be considerable reduction of the atmospheric contaminants and combustible materials. The general method of catalytic combustion should have possibilities for use in the field of atmospheric pollution control wherever the contaminants are combustible or readily oxidized to less irritant compounds.

★ ★ ★

Each installation should have chemical and physical tests made on the oven and stack effluents in order to determine the optimum operating conditions and verify the reduction of the contaminants that are the source of the atmospheric pollution problem. It is also evident that a minimum of instrumentation should be necessary for indicating the continued activity of the catalyst.

★ ★ ★

Although encouraging results have been attained with this catalytic combustion installation, the entire project is still in the experimental stage. Due to the very close controls that are necessary in the operation of the wire enameling ovens in order to produce acceptable enameled wire, each modification must be thoroughly checked from all operating angles. Additional tests are being conducted as the equipment is modified, especially the elimination of the Gas Burner, in order to arrive at the best solution to the atmospheric pollution problem caused by wire enameling ovens.

★ ★ ★

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Following extensive field tests, the **Magnus Chemical Company**, Garwood, N. J., announces a new and highly effective cleaner for all kinds of metal parts, Magnus 751.

It is safe for all metals, not attacking, pitting or marring aluminum alloys, bearing metals, cadmium, solder, die cast or any other soft

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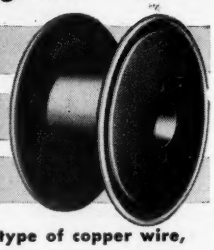

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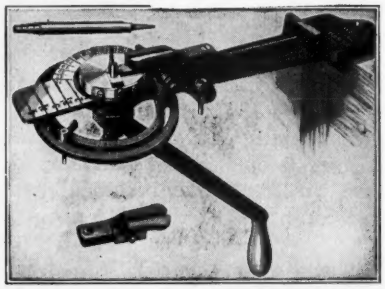

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metal. It is non-inflammable. It cleans at high speed, penetrating, loosening and removing all foreign deposits faster and better than ordinary cleaners. A characteristic is the long life of the cleaning solution. Cleaning costs are low, because of this feature. Magnus 751 can be used in either hot or cold solution and is followed by a simple cold water rinse after the cleaning period.

Because of its complete safety where any metal is concerned Magnus 751 will have great value in all kinds of cleaning operations on industrial equipment parts. Work can be placed in the cleaning solution and simply left there until it is needed. A pressure spray rinse with water or with safety solvent, gives you a part ready for use, thoroughly cleaned.

Where a large volume of parts has to be cleaned regularly, this cleaner works best when used in the Magnus Aja-Dip Cleaning Machine, where agitation speeds up the cleaning action and all traces of deposits are removed, making hand brushing unnecessary. This cleaner also strips paint and other coatings from the parts it cleans.

Magnus 751 closely follows Navy Aeronautical Specification C-86 and Army-Navy Aeronautical Specification AN-C-163.

★ ★ ★

Improvements in Cable Lacquers through the Years

(*Continued from page* 1050)

of the government requirements. As a matter of fact, this type of coating is currently being used. Its use, however, entails either a slightly different type of construction or the use of a specially designed saturant, or both. This construction is a barrier to the migration of plasticizer and also increases the ability of the primary insulation to withstand the solvent attack. Complete information concerning these applications is available from most cable lacquer manufacturers.

★ ★ ★

When coatings are being used on wire to meet JAN or MILW Specifications, there is tendency to specify the type of fungicidal agent to be incorporated in the coating and also the percentage. As you know, at

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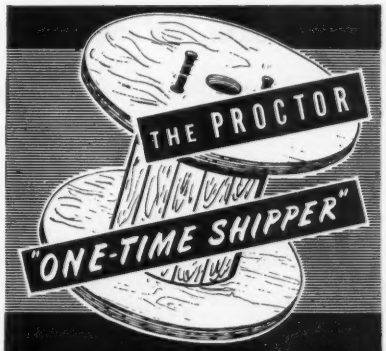

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the present time on proposed specifications, the percentage of the fungicidal agent has been increased to a minimum of 6% to a maximum of 8% based on total solids and specifying salicylanilide.

★ ★ ★

As we mentioned before, pentachlorophenol seems to have been excluded, probably because of the following reasons:

In order to obtain comparable fungicidal resistance, approximately 10% pentachlorophenol had to be added to the coating, which in turn did not help the electrical properties of the surface coating, as well as adding quite a bit of color to the coating.

★ ★ ★

Since the research departments at the New England Lacquer Company and at Scientific Oil Compounding Company have completed an extensive research project in running comparative tests between pentachlorophenol, salicylanilide, and copper-8-quinolinolate, you may be interested in some of our procedures and findings.

★ ★ ★

Two sets of wires were made up in the following manner. Wire coated with lacquer containing 10% pentachlorophenol; wire coated with lacquer containing 5% salicylanilide; wire coated with lacquers containing copper-8-quinolinolate in varying percentages to a low of .75% copper. In all cases, the base coating was the same.

★ ★ ★

Two sets were made up, one set was subjected to organisms after normal drying period, and the other set was subjected to heat for 48 hours at 230° F. before inoculation conditioning.

★ ★ ★

After the above conditioning, these sets were allowed an incubation period for 21 days at 85° F. and then were examined for visible growth.

★ ★ ★

Ten per cent of pentachlorophenol present in the lacquer film had a zone of inhibition evident when the unbaked wire sample was examined after the above. After baking, this protection disappeared. We understand that this is common in that pentachlorophenol is fugitive at temperatures above 185° F. In this test both the baked and unbaked samples containing 5% salicylanilide showed

growth, and during the course of the test, there was not the slightest zone of inhibition. Apparently, on the wires containing copper-8-quinolinolate, even in the smallest percentages which were as low as three-fourths of 1% of copper based on total solids, there was a complete absence of growth on or near the sample. A complete report on this work has been compiled and is available to those of you who have not received it.

★ ★ ★

At the present time, the use of copper-8-quinolinolate as a fungicide has not been approved, although the merits of this fungicidal agent are well recognized. One of the drawbacks to its use in clear coating is the slight greenish translucency it imparts to the coated wire. Of course, where color is not of importance, or where a pigment is contained in the film, copper-8-quinolinolate can undoubtedly be used. As a matter of fact, we are at the present time using copper-8-quinolinolate in coatings for the electrical field, especially where a black pigmented type of so-called spaghetti tubing is being manufactured.

★ ★ ★

For this use, the basic film which has been developed for high-heat resistance, plus this type of fungicide results in a more heat-resistant and fungicidal resistant construction than normally expected from the lacquer type of tubing. In our plastisol work which must be cured at temperatures between 350 to 400° F., this seems to be the only acceptable type of fungicidal agent that we know of at the present time.

★ ★ ★

These current efforts to develop fungicidal-resistant lacquers are an example of the type of lacquer research which has been in process continually since the first coatings were developed. The brief history of cable coatings which we have outlined here consists only of representative lacquer developments through the years. Although incomplete, the foregoing historical outline should make two facts very clear.

1. **Now that the construction of wire for modern uses has become so technically complicated in design, the coating which protects the wire has assumed a tremendous importance.**
2. **In order to correctly formulate lacquers for modern requirements, thorough research and testing procedures are an absolute necessity.**

★ ★ ★

Because of these two facts, wire manufacturers should be certain that the coating used for their wire has been skillfully formulated as a result of exhaustive laboratory research.

★ ★ ★

Competent cable lacquer manufacturers can assist wire producers greatly with these lacquer problems. Their specialized experience and skill in formulating and testing lacquers for insulated wire can often save the wire manufacturer considerable time and money.

★ ★ ★

The history of lacquer developments over the last eighty years clearly shows the willingness of lacquer producers to work closely with wire manufacturers to help solve their lacquer problems. Our aim is to keep just a little bit ahead of the ever-changing requirements of the wire industry!

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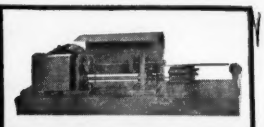
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Submit Lists, Samples, Description, Prices
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any capacity
BOX #623,
WIRE & WIRE PRODUCTS

WANTED: 1 10 block continuous dry drawing machine for drawing stainless steel wire from .060 to .020. Give full particulars, condition, availability and price. Reply Box No. 624, WIRE & WIRE PRODUCTS.

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Elgin National Watch Co., Abrasives Division, Elgin, Ill.
Norton Co., Worcester, Mass.

ACID INHIBITORS—
(See Inhibitors, Pickling)

ACID-PROOF CONSTRUCTION—
Ceilcote Company, Cleveland, Ohio
Chemsteel Construction Co., Pittsburgh, Pa.
Haveg Corporation, Newark, Del.
Heil Process Equipment Corp., Cleveland, Ohio.

ANNEALING MACHINES—Open Flame
Syncro Machine Co., Perth Amboy, N. J.

ANNEALING POTS AND BOXES—
Scudder, E. J. Foundry & Mach. Co., Trenton, N.J.

ARMORING EQUIPMENT—
American Insulating Machy. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R.I.

BAKERS—Rod and Wire
Carl-Mayer Corp., The, Cleveland, Ohio
Morgan Construction Co., Worcester, Mass.
Ross, J. O., Engr. Corp., New York, N. Y.

BAR STOCK—Stainless Steel
American Steel & Wire Company, Cleveland, Chicago, New York
U. S. Steel Corporation, New York, N. Y.

BOBBINS—Braider & Wire Weaving
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Standard Mill Supply Co., Pawtucket, R. I.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R.I.

BORAX—Wire Drawing
Pacific Coast Borax Corp., New York, N. Y.

BORON CARBIDE—
Norton Co., Worcester, Mass.

BRAKES—Pneumatic
Entwistle, Jas. L. Co., Pawtucket, R. I.

CABLE LACQUERING OVENS—
Industrial Ovens, Inc., Cleveland, O.

CARRIERS—Braider, High Speed
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New England Butt Co., Providence, R. I.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R.I.

CASTINGS—Wire Mill
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.

CEMENTS—Acid Proof
Ceilcote Company, Cleveland, Ohio

CEMENTS—Refractory
Norton Co., Worcester, Mass.

CHEMICALS—Cleaning
(See Cleaners—Metal)

CLEANERS—Metal
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Phila., Pa.
Du Pont de Nemours, E. I. & Co., Electrochemical Dept., Wilmington, Del.
Houghton, E. F., Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Metal & Thermit Corp., New York, N. Y.
Oakite Products, Inc., New York, N. Y.
Parkin Chemical Company, The, Pittsburgh, Pa.
Standard Industrial Compounds Co., Chicago, Ill.

CLEANING & PICKLING EQUIP.—
Ceilcote Company, Cleveland, Ohio
Chemsteel Construction Co., Pittsburgh, Pa.
Cleveland Tramrail Div., of the Cleveland Crane & Engineering Co., Wickliffe, O.
Haveg Corp., Newark, Del.
Heil Process Equipment Corp., Cleveland, Ohio
Holden, A. F., Company, The, Detroit, Mich.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, Ohio
Wilson, Lee, Engr. Co., Cleveland, Ohio
Youngstown Welding & Engineering Co., Youngstown, Ohio

CLOTH—WIRE, All Metals
Roebling's, John A. Sons, Co., Trenton, N. J.
Wickwire Bros., Cortland, N. Y.

COATING COMPOUNDS—
Apex Alkali Products Co., Philadelphia, Pa.
Houghton, E. F. & Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Pennsylvania Salt Mfg. Co., Philadelphia, Pa.
Standard Industrial Compounds Co., Chicago, Ill.
Trembicki Co., The, Chicago, Ill.

COILERS—Sheet, Strip and Wire
Entwistle, Jas. L. Co., Pawtucket, R. I.
Morgan Construction Co., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Wean Equipment Corp., Cleveland, O.

COLD HEADERS—
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

COMPOUNDS—Coppering
American Chemical Paint Co., Ambler, Pa.

COMPOUNDS—Diamond
Eastern Carbide Corp., New Rochelle, N. Y.
Elgin National Watch Co., Abrasives Division, Elgin, Ill.
Hyprez Div., Engis Equipment Co., Chicago, Ill.
Magnus Chemical Co., Garwood, N. J.

COMPOUNDS—For Improving Drawing and Extrusion
American Chemical Paint Co., Ambler, Pa.

COMPOUNDS—Metal Finishing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Du Pont de Nemours, E. I. & Co., Electrochemical Dept., Wilmington, Del.
Metal & Thermit Corp., New York, N. Y.

COMPOUNDS—Phosphate Coating
American Chemical Paint Co., Ambler, Pa.
Pennsylvania Salt Mfg. Co., Philadelphia, Pa.
Trembicki Co., The, Chicago, Ill.

COMPOUNDS—Rust Preventing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Houghton, E. F. & Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Oakite Products, Inc., New York, N. Y.

COMPOUNDS—Rust Removing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Houghton, E. F. & Co., Philadelphia, Pa.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

COMPOUNDS—Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Bick, Hans C., Inc., Reading, Pa.
Houghton, E. F. & Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H. Co., Inc., Homer, N. Y.
Nopco Chemical Co., Harrison, N. J.
Oakite Products, Inc., New York, N. Y.
Pacific Coast Borax Corp., New York, N. Y.
Pennsylvania Salt Mfg. Co., Philadelphia, Pa.
Standard Industrial Compounds Co., Chicago, Ill.
Swift & Company, Chicago, Ill.
Trembicki Co., The, Chicago, Ill.

CONDUCTORS—Flexible, Electrical
Montgomery Co., The, Windsor Locks, Conn.

COPHOLDERS—Steel
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R.I.

CORDS—Electrical, Tinsel Conductor
Montgomery Co., The, Windsor Locks, Conn.

CORROSION PREVENTIVE PAPERS—
Angier Corporation, The, Framingham, Mass.

CRANES—Wire Mill
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

CUTTING TOOLS—Carbide
Carboloy Dept. of General Electric Co., Detroit, Mich.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth-Sterling Steel & Carbide Corp., McKeesport, Pa.
Metal Carbides Corporation, Youngstown, Ohio
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.

CUTTING TOOLS—Wire
Porter, H. K., Inc., Everett, Mass.

DIAMONDS—Industrial
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIAMOND POWDERS—
Danforth, The C. W. Co., Youngstown, Ohio
Eastern Carbide Corp., New Rochelle, N. Y.
Elgin National Watch Co., Abrasives Division, Elgin, Ill.
Hyprez Div., Engis Equipment Co., Chicago, Ill.
Indiana Wire Die Co., Ft. Wayne, Ind.
National Research Company, St. Claire Shores, Mich.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIAMOND POWDER RECLAIMING—
Danforth, The C. W. Co., Youngstown, Ohio
National Research Co., St. Claire Shores, Mich.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.

DIAMOND TOOLS—
Carboloy Dept. of General Electric Co., Detroit Mich.
Indiana Wire Die Co., Ft. Wayne, Ind.
Metal Carbides Corporation, Youngstown, Ohio
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIES—Carbide
(See Dies—Tungsten Carbide)

DIES—Cold Heading
American Carbide Die Company, Union City, N. J.
Carboloy Dept. of General Electric Co., Detroit, Mich.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth-Sterling Steel & Carbide Corp., McKeesport, Pa.
Indiana Wire Die Co., Ft. Wayne, Ind.
Metal Carbides Corporation, Youngstown, Ohio.
Vascoloy-Ramet Corp., No. Chicago, Ill.

DIES—Diamond
Ajax Industrial Supplies, Inc., Fort Wayne, Ind.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Boulin, Victor J., New York, N. Y.
Cochaud Wire Die Corp., New York, N. Y.
Ft. Wayne Wire Die, Inc., Fort Wayne, Ind.
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
New England Wire Die Co., Worcester, Mass.
North American Philips Co., Inc., New York, N.Y.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIES—Extrusion
American Carbide Die Company, Union City, N. J.
Carboloy Dept. of General Electric Co., Detroit, Mich.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth-Sterling Steel & Carbide Corp., McKeesport, Pa.
Hartley Tool & Die Co., Thomaston, Conn.
Metal Carbides Corporation, Youngstown, Ohio.
Murex, Ltd., Rainham, England.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIES—Eyelet
American Carbide Die Company, Union City, N. J.
Eastern Carbide Corp., New Rochelle, N. Y.
Hartley Tool & Die Co., Thomaston, Conn.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.

DIES—Pointing
Sjogren Tool and Machine Co., Auburn, Mass.

DIES—Repairs & Re-Cutting
American Carbide Die Company, Union City, N. J.
Ajax Industrial Supplies, Inc., Fort Wayne, Ind.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Boulin, Victor J., New York, N. Y.
Carboloy Dept. of General Electric Co., Detroit, Mich.
Cochaud Wire Die Corp., New York, N. Y.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth-Sterling Steel & Carbide Corp., McKeesport, Pa.
Ft. Wayne Wire Die, Inc., Fort Wayne, Ind.
Hartley Tool & Die Co., Thomaston, Conn.
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corporation, Youngstown, Ohio.
New England Wire Die Co., Worcester, Mass.
North American Philips Co., Inc., New York, N. Y.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Wayne Wire Die Co., Hillside, N. J.

WHERE TO BUY, Continued

DIES—Special Shapes, Etc.
American Carbide Die Company, Union City, N. J.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth-Sterling Steel & Carbide Corp., McKeesport, Pa.
Hartley Tool & Die Co., Thomaston, Conn.
Indiana Wire Die Co., Ft. Wayne, Ind.
Murex, Ltd., Rainham, England.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.

DIES—Swaging
Murex, Ltd., Rainham, England
Sjogren Tool and Mach. Co., Inc., Auburn, Mass.

DIES—Tantalum Carbide
American Carbide Die Company, Union City, N. J.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Carboloy Dept. of General Electric Co., Detroit, Mich.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth-Sterling Steel & Carbide Corp., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corporation, Youngstown, Ohio
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.

DIES—Tube Drawing
American Carbide Die Company, Union City, N. J.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Carboloy Dept. of General Electric Co., Detroit, Mich.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth-Sterling Steel & Carbide Corp., McKeesport, Pa.
Hartley Tool & Die Co., Thomaston, Conn.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corp., Youngstown, O.
Murex, Ltd., Rainham, England.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.

DIES—Tungsten Carbide
American Carbide Die Company, Union City, N. J.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Carboloy Dept. of General Electric Co., Detroit, Mich.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth-Sterling Steel & Carbide Corp., McKeesport, Pa.
Hartley Tool & Die Co., Thomaston, Conn.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corp., Youngstown, O.
Murex, Ltd., Rainham, England.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Wayne Wire Die Co., Hillside, N. J.

DRAW BENCHES—
(See MACHINERY—Draw Benches)

DRUMS—Flange Steel
Hubbard Spool Company, Chicago, Ill.
Niles Steel Products Division, Republic Steel Corporation, Niles, Ohio

DRUMS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.
Watson Machine Co., The, Paterson, N. J.

DRYING EQUIPMENT—
Carl-Mayer Corp., The, Cleveland, Ohio
Industrial Ovens, Inc., Cleveland, Ohio
Rockwell, W. S. Co., Fairfield, Conn.
Ross, J. O., Engineering Corp., New York, N. Y.

ENGINEERS—Consulting
Copper—Leonard D. Walde, North Plainfield, N. J.
Metal Fatigue—Fatigue of Materials Laboratory, Princeton, N. J.
Wire Mill—Lewis, Kenneth B., Worcester, Mass.

EQUIPMENT—Insulation Testing
Davis Elec. Co., Wallingford, Conn.
Entwistle, James L., Co., Pawtucket, R. I.

EYELETS—Brass or Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FENCING & FENCES—Wire
Interlocking Fence Co., Morton, Ill.

FLUXES—Soldering
American Chemical Paint Co., Ambler, Pa.

FOAM PRODUCING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa
Parkin Chemical Company, The, Pittsburgh, Pa.

FRICTION PAY-OFF STANDS—
Industrial Ovens, Inc., Cleveland, Ohio.

FURNACES—Annealing
Ajax Electric Co., Inc., Philadelphia, Pa.
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N. Y.
Holden, A. F., Co., The, Detroit, Mich.
Rockwell, W. S. Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engr. Co., Cleveland, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Automatic
Electric Furnace Co., Salem, Ohio.
Surface Combustion Corp., Toledo, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Brazing
Electric Furnace Co., Salem, Ohio.
Rockwell, W. S. Co., Fairfield, Conn.

FURNACES—Bright Annealing
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N. Y.
Michigan Oven Co., Detroit, Mich.
Rockwell, W. S. Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Electric
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N. Y.
Rockwell, W. S. Co., Fairfield, Conn.
Trauwood Engineering Co., The, Cleveland, Ohio.

FURNACES—Galvanizing Equipment
Ajax Electric Co., Inc., Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio.
Holden, A. F., Co., The, Detroit, Mich.
Rockwell, W. S. Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engineering Co., The, Cleveland, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Hard'ing & Temp'ing
Ajax Electric Co., Inc., Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N. Y.
Holden, A. F., Co., The, Detroit, Mich.
Rockwell, W. S. Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engineering Co., The, Cleveland, Ohio.

FURNACES—Lead Melting
Electric Furnace Co., Salem, Ohio.
Rockwell, W. S. Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Non-Oxidizing
Ajax Electric Co., Inc., Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio.
Holden, A. F., Co., The, Detroit, Mich.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Normalizing
Ajax Electric Co., Inc., Philadelphia, Pa.
Carl-Mayer Corp., The, Clevel nd, Ohio.
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N. Y.
Holden, A. F., Co., The, Detroit, Mich.
Rockwell, W. S. Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Pot (oil, gas, electric)
Ajax Electric Co., Inc., Philadelphia, Pa.
Holden, A. F., Co., The, Detroit, Mich.

FURNACES—Resistance Heating, Strand
Trauwood Engineering Co., The, Cleveland, Ohio.

FURNACES—Salt Bath
Ajax Electric Co., Inc., Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio.
Holden, A. F. Co., The, Detroit, Mich.
Rockwell, W. S. Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Wire, Strip & Sheet
Carl-Mayer Corp., The, Cleveland, Ohio.
Eisler Engineering Co., Newark, N. J.
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N. Y.
Michigan Oven Co., Detroit, Mich.
Rockwell, W. S. Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engineering Co., The, Cleveland, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

GALVANIZING EQUIPMENT—
Steel Equipment Co., Cleveland, Ohio.
Wean Equipment Corp., Cleveland, Ohio.

GRINDERS—Roll
Norton Co., The, Worcester, Mass.

HAMMERS—Swaging
Sjogren Tool and Machine Co., Auburn, Mass.

HOOKS—Pickling & Liming
Bronze Die Casting Co., Pittsburgh, Pa.
Youngstown Welding & Engineering Co., Youngstown, Ohio.

HOISTS—Electric Travelling
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, Ohio.

IMPREGNATING MATERIALS—
Standard Varnish Works, New York, N. Y.

INHIBITORS—Pickling
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Du Pont de Nemours, E. I. & Co., Electrochemical Dept., Wilmington, Del.
Houghton, E. F. & Co., Philadelphia, Pa.
Oakite Products, Inc., New York, N. Y.
Parkin Chemical Company, The, Pittsburgh, Pa.
Pennsylvania Salt Mfg. Co., Philadelphia, Pa.

INSULATING LACQUERING SYSTEMS—Continuous
American Insulating Machine Co., Phila., Pa.
Industrial Ovens, Inc., Cleveland, Ohio.

INSULATING MATERIALS—
Du Pont de Nemours, E. I., Co., Wilmington, Del.
Glass Fibers, Inc., Waterville, Ohio.
Merrimac Paper Co., New York, N. Y.
New England Lacquer Co., E. Providence, R. I.
Owens Corning Fiberglas Corp., Toledo, O.
Standard-Toch Chemicals, Inc., New York, N. Y.
Twitchell, E. W., Philadelphia, Pa.

INSULATING MATERIALS—Paper—For Electric Wire Cable.
Merrimac Paper Co., New York, N. Y.
Twitchell, E. W., Philadelphia, Pa.

LACQUERS—For Electric Wire
New England Lacquer Co., E. Providence, R. I.
Standard-Toch Chemicals, Inc., New York, N. Y.

LAME—LAHN—
Montgomery Co., The, Windsor Locks, Conn.

LATHES—Die Reaming
Carboloy Dept. of General Electric Co., Detroit, Mich.
Roos, Tool & Mfg. Co., Montclair, N. J.

LIME—
Warner Co., Philadelphia and Bellefonte, Pa.

LININGS—Acid and Alkali Proof
Haveg Corp., Newark, Del.
Heil Process Equipment Corp., Cleveland, Ohio

LUBRICANTS — For Metal Cutting, Stamping and Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Houghton, E. F. & Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Nopco Chemical Co., Harrison, N. J.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

LUBRICANTS—Wire Drawing
(See Compounds—Wire Drawing)

LUBRICANTS—Wire Rope
Swift & Co., Chicago, Ill.

LUMBER—Wire Mill, Carload shipments for lagging and car blocking
North Anson Reel Co., No. Anson, Me.

MACHINERY—Armoring (Cable, Wire Hose)
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Barbed Wire
Glader Machine Works, Chicago, Ill.
Wafios, Maschinenfabrik, Reutlingen, Germany
Wean Engineering Co., Cleveland, Ohio.

MACHINERY—Bead Wrapping
Terkelsen Machine Co., Boston, Mass.

MACHINERY—Bolts & Rivets
Meyer, Roth & Pastor Maschinenfabrik, Koln-Raderberg, Germany

MACHINERY—Braiding
Fidelity Machine Co., Inc., Philadelphia, Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.

WHERE TO BUY, Continued

New England Butt Co., Providence, R. I.
Wardwell Braiding Machine Co., Central Falls, R. I.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R.I.

MACHINERY—Brazing
Eisler Engineering Co., Newark, N. J.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Bunching
American Insulating Mach'y Co., Phila., Pa.
Cook, Edw., Machy. Co., Wallingford, Conn.
Federal Manufacturing Co., Wallingford, Conn.
Haskell-Dawes Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R.I.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Cable, Electric
American Insulating Mach'y Co., Phila., Pa.
Fidelity Machine Co., Inc., Philadelphia, Pa.
Haskell-Dawes Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cable, Rope Closing
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Chain Making
Meyer, Roth & Pastor Maschinenfabrik, Koln-Radderberg, Germany

MACHINERY—Coilers
Boyd & Sons Manufacturing Co., Phila., Pa.
Eisler Engineering Co., Newark, N. J.
Entwistle, Jas. L. Co., Pawtucket, R. I.
Morgan Construction Co., Worcester, Mass.
National Machy. Exch. (used) New York, N. Y.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.
Wean Equipment Corp., Cleveland, Ohio
Wire & Textile Mach'y, Inc. (used) Pawtucket, R.I.

MACHINERY—Cold Heading
(See Cold Headers)

MACHINERY—Copper Wire Drawing and Rolling
Aetna-Standard Engineering Co., Youngstown, Ohio
American Insulating Mach'y Co., Phila., Pa.
Fenn Manufacturing Co., The, Hartford, Conn.
National Mach'y Exch. (Used), New York, N. Y.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Covering Wire
American Insulating Mach'y Co., Phila., Pa.
Fidelity Machine Co., Inc., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Royle, John & Sons, Paterson, N. J.
Standard Machinery Co., Mystic, Conn.
Syncro Machine Co., Perth Amboy, N. J.
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cutting
Eisler Engineering Co., Newark, N. J.
Lewis Machine Co., The, Cleveland, Ohio
Mettler Machine Tool, Inc., New Haven, Conn.
National Mach'y Exch. (Used) New York, N. Y.
Porter, H. K., Inc., Everett, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Wean Equipment Corp., Cleveland, Ohio

MACHINERY—Die Making
Carboloy Dept. General Electric Co., Detroit, Mich.
Firth-Sterling Steel & Carbide Corp., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Roos Tool & Mfg. Co., Montclair, N. J.
Wayne Wire Die Co., Hillside, N. J.

MACHINERY—Draw Benches
Aetna-Standard Engineering Co., Youngstown, Ohio
Morgan Construction Co., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, Ohio

MACHINERY—Edging
Wean Equipment Corp., Cleveland, Ohio

MACHINERY—Enameling
American Insulating Mach'y Co., Phila., Pa.
Industrial Ovens, Inc., Cleveland, Ohio
Michigan Oven Co., Detroit, Mich.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Extruding
National Rubber Machinery Co., Akron, Ohio
Royle, John, & Sons, Paterson, N. J.
Standard Machinery Co., Mystic, Conn.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R.I.

MACHINERY—Fence
Glader, Wm., Machine Works, Chicago, Ill.
Interlocking Fence Co., Morton, Ill.
Wafios, Maschinenfabrik, Reutlinger, Germany
Wean Equipment Corp., Cleveland, Ohio

MACHINERY—Filament Coil Winding
Eisler Engineering Co., Newark, N. J.

MACHINERY—Flat Wire
Fenn Manufacturing Co., The, Hartford, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Stanat Manufacturer Co., Long Island City, N. Y.
Torrington Mfg. Co., Torrington, Conn.
Wean Equipment Corp., Cleveland, Ohio

MACHINERY—Galvanizing
(See Galvanizing Equipment)

MACHINERY—Galvanizing Wire
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Equipment Co., Cleveland, Ohio
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, O.
Wilson, Lee, Engr. Co., Cleveland, Ohio

MACHINERY—Gang Winders
Entwistle, Jas. L. Co., Pawtucket, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., The, Worcester, Mass.

MACHINERY—Insulating
American Insulating Mach'y Co., Phila., Pa.
Cook, Edw., Machy. Co., Wallingford, Conn.
Ets. Pourtier Frères, Romainville, France
Fidelity Machine Co., Inc., Philadelphia, Pa.
National Rubber Machinery Co., Akron, Ohio
New England Butt Co., Providence, R. I.
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Knitting
Fidelity Machine Co., Inc., Philadelphia, Pa.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Looms, Wire Weaving
Interlocking Fence Co., Morton, Ill.

MACHINERY—Magnet Wire
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Material Handling
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

MACHINERY—Measuring Wire & Cable
Davis Electric Co., Wallingford, Conn.
Durant Mfg. Co., Milwaukee, Wis.
Entwistle, Jas. L. Co., Pawtucket, R. I.
New England Butt Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Glader, Wm., Machine Works, Chicago, Ill.
Meyer, Roth & Pastor Maschinenfabrik, Koln-Radderberg, Germany
National Mach'y Exch. (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Wafios, Maschinenfabrik, Reutlinger, Germany
Wean Equipment Corp., Cleveland, Ohio

MACHINERY—Panning
American Insulating Mach'y Co., Phila., Pa.
Syncro Machine Co., Perth Amboy, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R.I.

MACHINERY—Pickling
Chemsteel Construction Co., Pittsburgh, Pa.
Youngstown Welding & Engineering Co., Youngstown, Ohio

MACHINERY—Pin Making
Meyer, Roth & Pastor Maschinenfabrik, Koln-Radderberg, Germany

MACHINERY—Pointing
Aetna-Standard Engineering Co., Youngstown, Ohio
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York, N. Y.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Wean Equipment Corp., Cleveland, Ohio

MACHINERY—Poultry Wire Fencing
Interlocking Fence Co., Morton, Ill.

MACHINERY—Pre-Heater for Wire (for Extrusion of Plastics)
Industrial Ovens, Inc., Cleveland, Ohio
National Rubber Machinery Co., Akron, Ohio

MACHINERY—Rod Mill
Morgan Construction Co., Worcester, Mass.
Wean Equipment Corp., Cleveland, Ohio

MACHINERY—Rolling Mill
Morgan Construction Co., Worcester, Mass.
National Machy. Exch. (used) New York, N. Y.
Stanat Manufacturer Co., Long Island City, N. Y.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Wean Engineering Co., Cleveland, Ohio

MACHINERY—Rubber Insulating
National Rubber Machinery Co., Akron, Ohio
Royle, John & Sons, Paterson, N. J.
Standard Machinery Co., Mystic, Conn.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R.I.

MACHINERY—Rubber Tubing and Straining
National Rubber Machinery Co., Akron, Ohio
New England Butt Co., Providence, R. I.
Royle, John & Sons, Paterson, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Mystic, Conn.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R.I.

MACHINERY—Screw Wire
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Special
American Insulating Mach'y Co., Phila., Pa.
Davis Electric Co., Wallingford, Conn.
Emory, Robert J., Co., Newark, N. J.
Entwistle, Jas. L. Co., Pawtucket, R. I.
New England Butt Co., Providence, R. I.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sjogren Tool and Machine Co., Auburn, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Stanat Manufacturer Co., Long Island City, N. Y.
Standard Machinery Co., Mystic, Conn.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wean Equipment Corp., Cleveland, Ohio

MACHINERY—Spooling
American Insulating Mach'y Co., Phila., Pa.
Boyd & Sons Manufacturing Co., Phila., Pa.
Davis Electric Co., Wallingford, Conn.
Eisler Engineering Co., Newark, N. J.
Emory, Robert J., Co., Newark, N. J.
Entwistle, Jas. L. Co., Pawtucket, R. I.
Fidelity Machine Co., Inc., Philadelphia, Pa.
National Mach'y Exch. (Used), New York, N. Y.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Equipment Co., Cleveland, Ohio
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.
Wean Equipment Corp., Cleveland, Ohio
Wire & Textile Mach'y, Inc. (used) Pawtucket, R.I.

MACHINERY—Spring Making
Carlson Company, The, New York, N. Y.
Lundahl Corp., Hartford, Conn.
National Mach'y Exch. (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Wafios, Maschinenfabrik, Reutlinger, Germany
Wells, Frank L., Co., Kenosha, Wisc.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.
Wafios, Maschinenfabrik, Reutlinger, Germany

MACHINERY—Straightening & Cutting
Fenn Manufacturing Co., The, Hartford, Conn.
Lewis Machine Co., The, Cleveland, Ohio
Mettler Machine Tool Co., New Haven, Conn.
Meyer, Roth & Pastor Maschinenfabrik, Koln-Radderberg, Germany
National Mach'y Exch. (Used), New York, N. Y.
Nors-Hohm Industries, Rochester, Michigan
Sleeper & Hartley, Inc., Worcester, Mass.
Wean Equipment Corp., Cleveland, Ohio
Wells, Frank L., Co., Kenosha, Wisc.

MACHINERY—Stranding
Haskell-Dawes Machine Co., Philadelphia, Pa.
Hughesville Machine & Tool Co., Hughesville, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Steel
Aetna-Standard Engineering Co., Youngstown, Ohio
Steel Equipment Co., Cleveland, Ohio
Wean Equipment Corp., Cleveland, Ohio

MACHINERY—Swaging
Fenn Manufacturing Co., The, Hartford, Conn.
National Mach'y Exch. (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Taping
American Insulating Mach'y Co., Phila., Pa.
Ets. Pourtier Frères, Romainville, France
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.

WHERE TO BUY, Continued

Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R.I.

MACHINERY—Testing, Physical
Lundahl Corporation, Hartford, Conn.
Scott Testers, Inc., Providenec, R. I.

MACHINERY—Testing Equipment—Electrical
Davis Electric Co., Wallingford, Conn.
Entwistle, Jas. L. Co., Pawtucket, R. I.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R.I.

MACHINERY—Tinning Wire
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Steel Equipment Co., Cleveland, Ohio.
Syncro Machine Co., Perth Amboy, N. J.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y Co., Phila., Pa.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Trolley Wire
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill
Marshall-Richards Machine Company, Inc., Trenton, N. J.

MACHINERY—Twinning
(See Mach.—Bunching)

MACHINERY—Twisters, Wire
Cook, Edw., Machy. Co., Wallingford, Conn.
Davis Electric Co., Wallingford, Conn.
Federal Manufacturing Co., Wallingford, Conn.

MACHINERY—Welding Wire
Eisler Engineering Co., Newark, N. J.
Micro Products Co., Chicago, Ill.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Winding
American Insulating Mach'y Co., Phila., Pa.
Eisler Engineering Co., Newark, N. J.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Mill Supply, Pawtucket, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Winding Wire
Federal Manufacturing Co., Wallingford, Conn.
Standard Mill Supply, Pawtucket, R. I.

MACHINERY—Wind-up (Constant Tension, Variable Speed)
Aetna-Standard Engineering Co., Youngstown, Ohio
Davis Electric Co., Wallingford, Conn.
Federal Manufacturing Co., Wallingtord, Conn.
Industrial Ovens, Inc., Cleveland, Ohio
Marshall-Richards Machine Co., Inc., Trenton, N.J.
Standard Machine Co., Mystic, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Bending
Eisler Engineering Co., Newark, N. J.
Kilmer, M. D., & Co., Cleveland, Ohio.

MACHINERY—Wire Drawing
Aetna-Standard Engineering Co., Youngstown, Ohio
American Insulating Mach'y Co., Phila., Pa.
Fenn Manufacturing Co., The, Hartford, Conn.
Kurt Orban Co., Inc., New York, N. Y.
Marshall-Richards Machine Co., Inc., Trenton, N.J.
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York, N. Y.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Equipment Co., Cleveland, Ohio.
Svenska Telegrambyran (Morgardshammer), Stockholm, Sweden
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Wire Forming
Kilmer, M. D. & Co., Cleveland, Ohio.
Meyer, Roth & Pastor Maschinenfabrik, Koln-Radderberg, Germany
National Mach'y Exch. (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Wafios, Maschinenfabrik, Reutlinger, Germany

MACHINERY—Wire Rope
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wood Screw
National Mach'y Exch. (Used), New York, N. Y.

MACHINERY—Wrapping Straight Lengths and Tubing
Angier Corporation, The, Framingham, Mass.
Terkelsen Machine Co., Boston, Mass.

MACHINERY—Wrapping Wire Coils
Angier Corporation, The, Framingham, Mass.
Terkelsen Machine Co., Boston, Mass.

MATERIAL HANDLING EQUIPMENT—
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

MILLS—Tandem, Rolling & Edging
Torrington Mfg. Co., Torrington, Conn.
Wean Equipment Co., Cleveland, Ohio.

NAILS—Wire
American Steel & Wire Co., Cleveland, Chicago, New York.
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling, John A. Sons Co., Trenton, N. J.
Wickwire Brothers, Inc, Cortland, N. Y.

OVENS—Cable Lacquering
American Insulating Mach'y Co., Phila., Pa.
Carl-Mayer Corp., The, Cleveland, Ohio.
Industrial Ovens, Inc., Cleveland, Ohio.
Michigan Oven Co., Detroit, Mich.

OVENS—Dehydrogenizing
Industrial Ovens, Inc., Cleveland, Ohio.

OVENS—Industrial
Industrial Ovens, Inc., Cleveland, Ohio.
Michigan Oven Co., Detroit, Mich.
Ross, J. O., Engr. Corp., New York, N. Y.

OVENS—Rod Bakers
Carl-Mayer Corp., The, Cleveland, Ohio.
Michigan Oven Co., Detroit, Mich.
Ross, J. O., Engr. Corp., New York, N. Y.

OVENS—Welding Rod Coating
Carl-Mayer Corp., The, Cleveland, Ohio.
Industrial Ovens, Inc., Cleveland, Ohio.
Ross, J. O., Engr. Corp., New York, N. Y.

PAINT—Acid Proof
Ceilcote Company, Cleveland, Ohio.
Standard-Toch Chemicals, Inc., New York, N. Y.

PAINT BONDING CHEMICALS—
American Chemical Paint Co., Ambler, Pa.

PAINTS—Heat Resisting
American Chemical Paint Co., Ambler, Pa.
Standard-Toch Chemicals, Inc., New York, N. Y.

PANS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

PAPER—Creped Wrapping
Angier Corporation, The, Framingham, Mass.
Crepe-Kraft Company, The, Division National Waterproof Papers, Inc., Newark, N. J.
Terkelsen Machine Co., Boston, Mass.

PAPER—For Coil Wrapping and Corrosion Prevention
Angier Corporation, The, Framingham, Mass.
Crepe-Kraft Company, The, Division National Waterproof Papers, Inc., Newark, N. J.
Terkelsen Machine Co., Boston, Mass.

PATENT ATTORNEYS—
Lancaster, Allwine & Rommel, Washington, D. C.

PAY-OUT SYSTEMS—
(See Wind-up and Unwind Systems)

PHOSPHATE COATING CHEMICALS—
American Chemical Paint Co., Ambler, Pa.
Oakite Products, Inc., New York, N. Y.

PICKLING COMPOUNDS—
See (Inhibitors—Pickling)

PICKLING—Hooks, etc. Acid Resisting
Bronze Die Casting Co., Pittsburgh, Pa.
Youngstown Welding & Eng. Co., Youngstown, O.

PICKLING TANK LININGS—
Chemsteel Construction Co., Pittsburgh, Pa.
Haveg Corp., Newark, Del.
Heil Process Equipment Corp., Cleveland, Ohio.

PIPES & FITTINGS—Acid Resistant
Haveg Corp., Newark, Del.
Heil Process Equipment Corp., Cleveland, Ohio.

PLASTIC TESTERS—
Scott Testers, Inc., Providence, R. I.

PNEUMATIC CYLINDERS—
Entwistle, Jas. L. Co., Pawtucket, R. I.

POTS—Lacquer
Industrial Ovens, Inc., Cleveland, Ohio.

PRESSES—Hydraulic and Mechanical
Standard Machinery Co., Mystic, Conn.

PULLERS AND GRIPS—For Wire
Morgan Construction Co., Worcester, Mass.
Scudder, E. J. Fdry & Mach. Co., Trenton, N. J.
Sjogren Tool and Machine Co., Auburn, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, Ohio.

REEL AND TENSION STANDS—
Davis Electric Co., Wallingford, Conn.
Entwistle, Jas. L. Co., Pawtucket, R. I.
Industrial Ovens, Inc., Cleveland, Ohio.
Roll-a-Reel, Cincinnati, Ohio.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Mill Supply Co., Pawtucket, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

REEL CRUTCHES—
Roll-a-Reel, Cincinnati, Ohio
Watson Machine Co., Paterson, N. J.

REELS & SPOOLS—Drawn Aluminum Alloy
Acrometal Products, Inc., Minneapolis, Minn.
Hubbard Spool Co., Chicago, Ill.

REELS & SPOOLS—Annealing and Stranding
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp. Niles, Ohio.

REELS & SPOOLS—Collapsible
Entwistle, Jas. L. Co., Pawtucket, R. I.

REELS & SPOOLS—Plastic
Hubbard Spool Co., Chicago, Ill.

REELS & SPOOLS—Steel
Apco Mossberg Co., Attleboro, Mass.
Clark, J. L., Mfg. Co., Rockford, Ill.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Co., Chicago, Ill.
Mason Can Company, East Providence, R. I.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp. Niles, Ohio.

REELS AND SPOOLS—Shipping and Shop
Acrometal Products, Inc., Minneapolis, Minn.
American Woodworking Co., Chicago, Ill.
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg. Co., Inc., The, Hazardville, Conn.
Clark, J. L., Mfg. Co., Rockford, Ill.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Co., Chicago, Ill.
Mason Can Company, East Providence, R. I.
McCaskie, Inc., Wm., Westport, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp. Niles, Ohio.
North Anson Reel Co., No. Anson, Me.
Proctor Reels, Proctorville, Vt.

REELS & SPOOLS—Wooden
Acrometal Products, Inc., Minneapolis, Minn.
American Woodworking Co., Chicago, Ill.
Bridge Mfg. Co., Inc., The, Hazardville, Conn.
Durkee Mfg. Co., Pine River, Minn.
Nelson Co., The, Baltimore, Md.
North Anson Reel Co., No. Anson, Me.
No. Waterford Spool Co., No. Waterford, Me.
Proctor Reels, Proctorville, Vt.

REELS—Metal Bound
Durkee Mfg. Co., Pine River, Minn.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Co., Chicago, Ill.
McCaskie, Inc., Wm., Westport, Mass.
North Anson Reel Co., No. Anson, Me.

REELS—Pay-off
Nors-Holm Industries, Rochester, Mich.

REELS—Takeoff
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg. Co., The, Hazardville, Conn.
Clark, J. L., Mfg. Co., Rockford, Ill.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Co., Chicago, Ill.
McCaskie, Inc., Wm., Westport, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp Niles, Ohio.
North Anson Reel Co., No. Anson. Me.
Proctor Reels. Proctorville. Vt.

REELS—Vulcanizing & Impregnating
Apco Mossberg Co., Attleboro, Mass.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio

REELS—Wire Drawing
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

WHERE TO BUY, Continued

REELS—Wire Mill
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg. Co., The, Hazardville, Conn.
Durkee Mfg. Co., Pine River, Minn.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Co., Chicago, Ill.
Mason Can Company, East Providence, R. I.
McCaskie, Inc., Wm., Westport, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp. Niles, Ohio.
North Anson Reel Co., No. Anson, Me.
Proctor Reels, Proctorville, Vt.

REFRACTORIES—High Temperature
Norton Company, Worcester, Mass.

RESISTANCE HEATING—Annealing Patenting, Etc.
Trauwood Engr. Co., Cleveland, Ohio.

ROD BAKERS—
(See Ovens—Rod Bakers)

RODS—Stainless Steel
American Steel & Wire Co., Cleveland, Ohio.
U. S. Steel Co., N. Y., N. Y.

RODS—Wire—Non-Ferrous
American Brass Co., The, Waterbury, Conn.
Platt Bros. & Co., The, Waterbury, Conn.

RODS—Wire, Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Indiana.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Company, Pittsburgh, Pa.
Roebling's, John A., Sons Co., Trenton, N. J.
Montan Export, Inc., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

ROPE—Wire
American Steel & Wire Company, Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Roebling's John A., Sons Co., Trenton, N. J

RUBBER AND RUBBER COMPRESSION TESTERS—
Scott Testers, Inc., Providence, R. I.

RUST PROOF COMPOUNDS—
(See Compounds—Rust Preventing)

RUST REMOVING COMPOUNDS—
(See Compounds—Rust Preventing)

SALTS—Heat Treating, Descaling, etc.
Holden, A. F., Co., The, Detroit, Mich.
Houghton, E. F. & Co., Philadelphia, Pa.

SATURATION SYSTEMS—
Industrial Ovens, Inc., Cleveland, Ohio.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R.I.

SOAPS—Industrial and Wire Drawing
(See Compounds—Wire Drawing)

SODIUM—for Descaling
Du Pont de Nemours, E. I. & Co., Electrochemical Dept., Wilmington, Del.
Holden, A. F., Co., The, Detroit, Mich.

SOLVENT RESIN SYSTEMS—Experimental
Industrial Ovens, Inc., Cleveland, Ohio.

SPOOLS—Stamped Metal for Retail Wire Sales
Clark, J. L. Mfg. Co., Rockford, Ill.
Mason Can Co., East Providence, R. I.

STAMPINGS—Steel
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.

STRIP—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Roebling's John A., Sons Co., Trenton, N. J.
Youngstown Sheet & Tube Co., Youngstown, O.

SWIFTS—Take-off
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Watson Machine Co., Paterson, N. J.

TANKS—Compound
Haveg Corp., Newark, Del.
Watson Machine Co., Paterson, N. J.

TANKS—Pickling
Ceilcote Company, Cleveland, Ohio.
Chemsteel Construction Co., Pittsburgh, Pa.
Haveg Corp., Newark, Del.

TANKS—Steel
Chemsteel Construction Co., Pittsburgh, Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.

TIES—WIRE—
(See Wire Ties)

TINNING PROCESS—
Du Pont de Nemours, E. I. & Co., Electrochemical Dept., Wilmington, Del.
Metal & Thermit Corp., New York, N. Y.

TINSEL—Cords, Decorative
(See: Tinsel—Electric Conductor)

TINSEL—Electric Conductor
Montgomery Co., The, Windsor Locks, Conn.

TINSEL—Electric Resistance
(See: Tinsel—Electric Conductor)

TINSEL—Lame, Silver and False Gold
(See: Tinsel—Electric Conductor)

TINSEL—Thread, Silver and False Gold
(See: Tinsel—Electric Conductor)

TINSEL—Thread, Decorative
(See: Tinsel—Electric Conductor)

TINSEL—Wire
(See: Tinsel—Electric Conductor)

TOOLS—Spring Forming
Lundahl Corporation, Hartford, Conn.

TOOLS—Wire Cutting
Porter, H. K., Inc., Everett, Mass.

TRAMRAIL SYSTEMS—
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

TRAVERSES—For Reels
Entwistle, Jas. L. Co., Pawtucket, R. I.
Hubbard Spool Company, Chicago, Ill.
Niles Steel Products Div., Republic Steel Corp. Niles, Ohio

TRAVERSE MECHANISMS—
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New England Butt Co., Providence, R. I.
Niles Steel Products Div., Republic Steel Corp. Niles, Ohio
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R.I.

TUBE BENDERS AND FORMERS—
H. D. Kilmer Co., Cleveland, Ohio.

TURKS HEADS—
Fenn Manufacturing Co., The, Hartford, Conn.

VALVES & FITTINGS—Acid Resistant
Haveg Corp., Newark, Del.

VARNISHES—for Electric Wire
N. E. Lacquer Co., E. Providence, R. I.
Standard-Toch Chemicals, Inc., New York, N. Y.

VULCANIZERS—
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS—
American Insulating Mach'y Co., Phila., Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.

WELDERS—Spot and Butt
Eisler Engineering Co., Newark, N. J.
Micro Products Co., Chicago, Ill.

WIND-UP AND UNWIND SYSTEMS—Continuous
American Insulating Mach'y Co., Phila., Pa.
Davis Electric Co., Wallingford, Conn.
Entwistle, Jas. L. Co., Pawtucket, R. I.
Federal Manufacturing Co., Wallingford, Conn.
Industrial Ovens, Inc., Cleveland, Ohio
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R.I.

WIRE—Alloy
Montan Export, Inc., New York, N. Y.

WIRE—Aluminum
Elmet Division, North American Philips Company, Inc., Lewistown, Maine
Malin & Co., Cleveland, Ohio

WIRE—Barbed
Interlocking Fence Co., Morton, Ill.

WIRE—Cast
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Cold Heading
American Steel & Wire Co., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's John A., Sons Co., Trenton, N. J.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Electric
American Brass Co., The, Waterbury, Conn.
Chase Brass & Copper Co., Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.
Malin & Co., Cleveland, Ohio

WIRE—Flat, Fine
Elmet Division, North American Philips Company, Inc., Lewistown, Maine
Montgomery Co., The, Windsor Locks, Conn.

WIRE—Manufacturers
American Steel & Wire Co., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Chase Brass & Copper Co., Waterbury, Conn.
Continental Steel Corp., Kokomo, Ind.
Johnson Steel & Wire Co., Worcester, Mass.
Keystone Steel & Wire Co., Peoria, Ill.
Montan Export, Inc., New York, N. Y.
Newbury Company, The, Boston, Mass.
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A., Sons Co., Trenton, N. J.
U. S. Steel Co., N. Y., N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Music
American Brass Co., The, Waterbury, Conn.
American Steel & Wire Co., Cleveland, Ohio
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Malin & Co., Cleveland, Ohio
Montan Export, Inc., New York, N. Y.
Newbury Company, The, Boston, Mass.
Specialty Wire Co., Inc., Worcester, Mass.

WIRE—Nickel Silver and Phosphor Bronze
American Brass Co., The, Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.
Malin & Co., Cleveland, Ohio.
Chase Brass & Copper Co., Waterbury, Conn.

WIRE—Non-Ferrous to Specifications for Special Purposes
American Brass Co., The, Waterbury, Conn.
American Steel & Wire Co., Cleveland, Ohio
Chase Brass & Copper Co., Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.
North American Philips Co., Inc., New York, N. Y.

WIRE—Oil Tempered
Pittsburgh Steel Co., Pittsburgh, Pa.

WIRE—Spring
American Brass Co., The, Waterbury, Conn.
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Keystone Steel & Wire Co., Peoria, Ill.
Newbury Company, The, Boston, Mass.
Pittsburgh Steel Co., Pittsburgh, Pa.
Specialty Wire Co., Inc., Worcester, Mass.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Stainless Steel
American Steel & Wire Co., Cleveland, Ohio
Firth Sterling Steel & Carbide Co., McKeesport, Pa.
Specialty Wire Co., Inc., Worcester, Mass.

WIRE—Steel—Also Coppered and Galvanized Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Straightening and Cutting
Pittsburgh Cut Wire Co., Pittsburgh, Pa.
Wickwire Brothers, Inc., Cortland, N. Y.

WIRE—Tungsten
North American Philips Co., Inc., New York, N.Y.

WIRE—Zinc
Platt Bros. & Co., The, Waterbury, Conn.

WIRE CLOTH—Industrial
Roebling's, John A., Sons Co., Trenton, N. J.
Wickwire Brothers, Inc., Cortland, N. Y.

WIRE—Weaving (Non-Ferrous)
American Brass Co., The, Waterbury, Conn.
Chase Brass & Copper Co., Waterbury, Conn.

WRAPPING PAPER—Creped
Crepe-Kraft Company, The, Division National Waterproof Papers, Inc., Newark, N. J.
Angier Corporation, The, Framingham, Mass.

YARNS & TAPES—
Du Pont de Nemours, E. I. Co., Wilmington, Del.
Glass Fibers, Inc., Waterville, Ohio
Owens Corning Fiberglas Corp., Toledo, Ohio
Twitchell, E. W., Philadelphia, Pa.

YARN TESTERS—
Scott Testers, Inc., Providence, R. I.

The WATSON MACHINE COMPANY

ESTABLISHED 1845

PATERSON 3, NEW JERSEY, U. S. A.

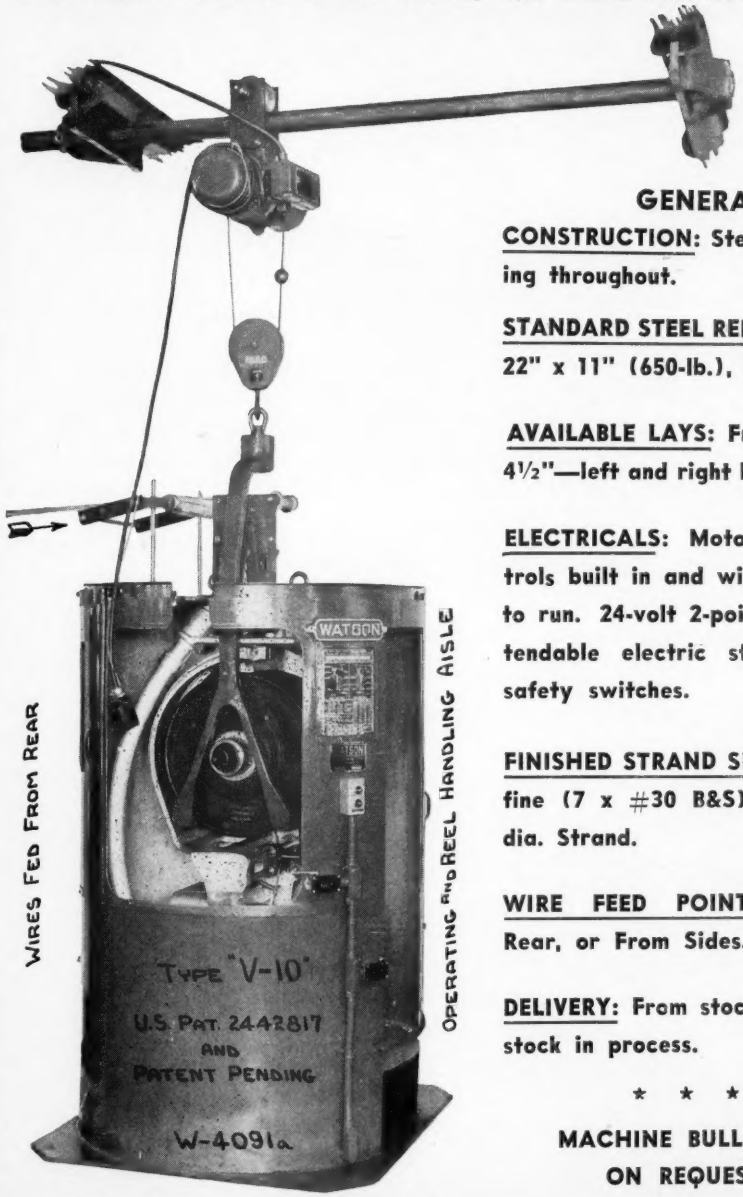
ELECTRICAL WIRE AND CABLE, WIRE ROPE, CORDAGE
AND MASTICATING MACHINERY MANUFACTURERS

WATSON

VERTICAL BUNCHERS TYPE "V"

IN WORLD-WIDE USE, THESE VERTICAL DESIGNS OFFER THE FOLLOWING OUTSTANDING ADVANTAGES:

1. HIGHEST POSSIBLE PRODUCTION AT LONG RUNS ON LARGE STANDARD WIRE TAKEUP REELS.
2. SMALLEST POSSIBLE FLOOR SPACE, AND IDEAL FOR ROW MOUNTING IN LIMITED SPACE.
3. LOW PURCHASE COST, ACHIEVED BY QUANTITY PRODUCTION.



GENERAL SPECIFICATIONS.

CONSTRUCTION: Steel, heat treated alloys and ball bearing throughout.

STANDARD STEEL REELS: No. 7—16" x 8" (250-lb.), No. 9—22" x 11" (650-lb.), No. 10—24" x 14" (1000-lb.).

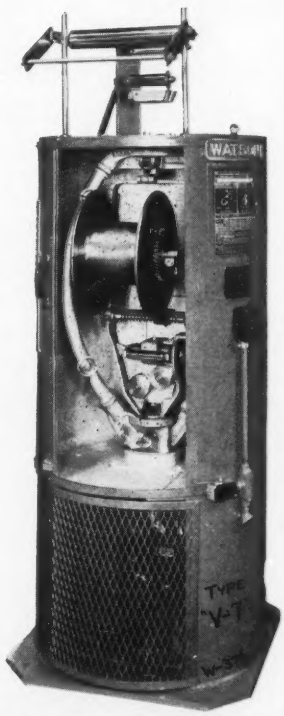
AVAILABLE LAYS: From 1/8" to 4½"—left and right hand twist.

ELECTRICALS: Motor & Controls built in and wired, ready to run. 24-volt 2-point and extendable electric stop. Door safety switches.

FINISHED STRAND SIZES: From fine (7 x #30 B&S) to 5/16" dia. Strand.

WIRE FEED POINTS: Front, Rear, or From Sides.

DELIVERY: From stock, or from stock in process.



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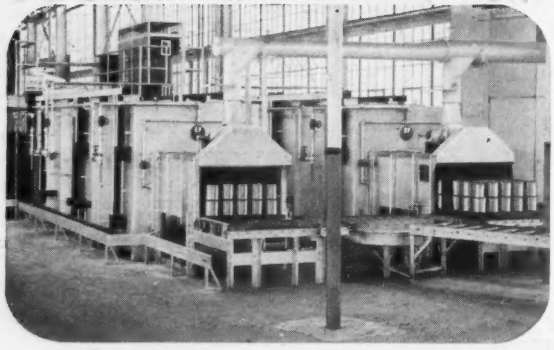
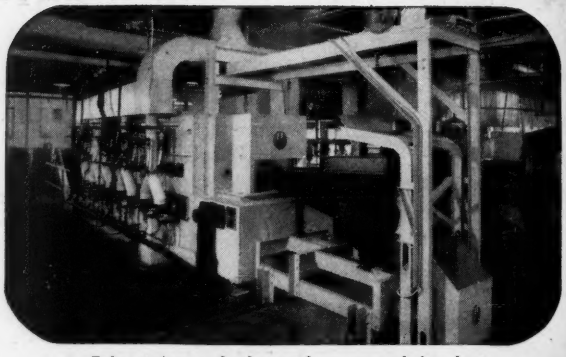
MACHINE BULLETINS ON REQUEST



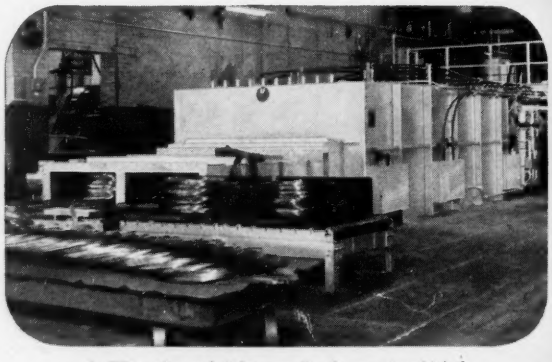
Bright annealing wire. EF gas-fired and electric furnaces are built in many sizes and types for bright annealing wire on spools or reels, in coils or strands—ferrous and non-ferrous, including stainless.



Bolts, springs and other products are scale-free heat treated in EF continuous chain belt conveyor furnaces similar to the above. 11 sizes—to handle from 125 to 2000 lbs. or more per hour. Hundreds are in operation.

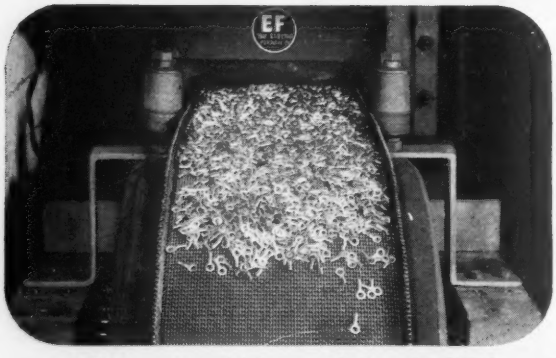
There's an EF

high efficiency production furnace



An EF continuous bright annealing furnace in which the wire is conveyed through the various zones on two parallel rows of bulkhead-type trays. This unit has convection cooling and handles 2500 net lbs. of wire per hour.

FOR EVERY annealing, heating or heat treating REQUIREMENT



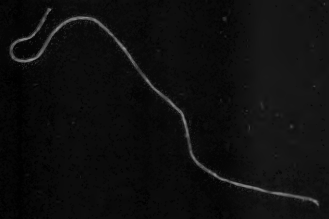
EF woven wire mesh belt conveyor furnaces are available in various widths—for a wide variety of products—for drawing, annealing, sintering, brazing and other heating processes—at temperatures up to 2100° F.

• For heating wire bars and billets—process annealing or normalizing—bright annealing ferrous, non-ferrous, stainless or other alloy wire—in coils or strands—on reels or spools—also for carbon restoration and non-decarb heat treating bolts and other rod or wire products—bluing, or any other heat treating process—investigate EF developments.

Our long experience—and complete line of batch and continuous furnaces featuring the many advantages available only in EF design—assures efficient operation, uniformity of finished product and satisfactory performance. Sizes to meet any capacity requirement.

Gas-Fired, Oil-Fired EF **and Electric Furnaces**

for any Process, Product or Production

THE ELECTRIC FURNACE CO.

WILSON ST. at PENNA. R. R. *Salem - Ohio*